C-ED

Reducing Power and Lightning Surges
Digital Transmission of Light-Wave Signals

Communications-Engineering Digest

Reporting the Technologies of Broadband Engineering

July 1978
Volume 4, No. 7

Oak protects your earth station investment!

Keep video raiders from tapping your earth station profits.

Now that you're paying for a new earth station, make sure all your subscribers are paying you. If you use soft security, video raiders may be tapping expensive premium programming and costing you megabucks. Let exclusive Oak pay TV security, help you maximize your profits.

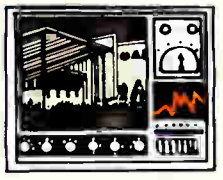
Conserves valuable space.

If your ship is filling up and space is tight, relax. Unlike competition, the Oak premium encoding/decoding information takes only a single TV channel. When you need two more channels of outer space without rebuild, the Econo-Code can be supplied with a two-channel option.

Space age scramblers... your secret weapons.

Reliable Oak scramblers offer the ultimate in security. In MDS applications, use the Mini-Scrambler at a remote site. For full systems, the Oak Mark II scrambler is used with your modulator at the head-end. Both employ the Oak sinewave sync suppression system for highest security.

Oak also offers an optional dual-level security system with both internal and pole-mounted components, so a decoder won't work in an unauthorized location.



Built and backed by Oak.

All Oak products are built by Oak people, in company owned facilities. This is a commitment to our customers and a symbol of our faith in the industry. We deliver what we promise, when we promise it. We follow up with service after the sale, rapid repair turn-around, and a one-year warranty for all customers.

Three ways to land bigger pay cable profits.

Oak decoding products give your system the best pay cable security in the industry. For 12-channel or MDS systems, the Mini-Code is the effective and economical choice. If you already have a full 12-channel system, you can add a channel with the Econo-Code single channel midband converter/decoder. For larger systems, the 35-channel Multi-Code is the best way to land bigger profits.

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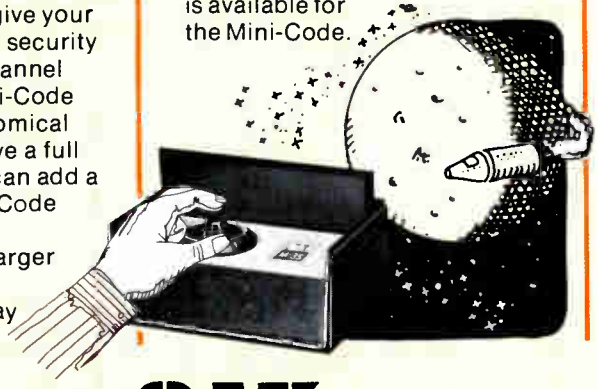
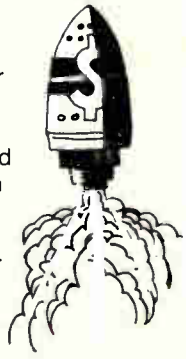
Remote controls give your customers fingertip command. With the Jewel Case Multi-Code remote, you can pre-determine any combination of encoded channels up to thirty-five. A single detent rotary control simplifies channel selection. A remote switch with control cord is available for the Mini-Code.



Bigger payloads!

You'll bring in bigger payloads because Oak decoders offer you performance and reliability, along with the security needed to beat the video raiders. Protect your profits and your system. Choose Oak.



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The goods are produced in

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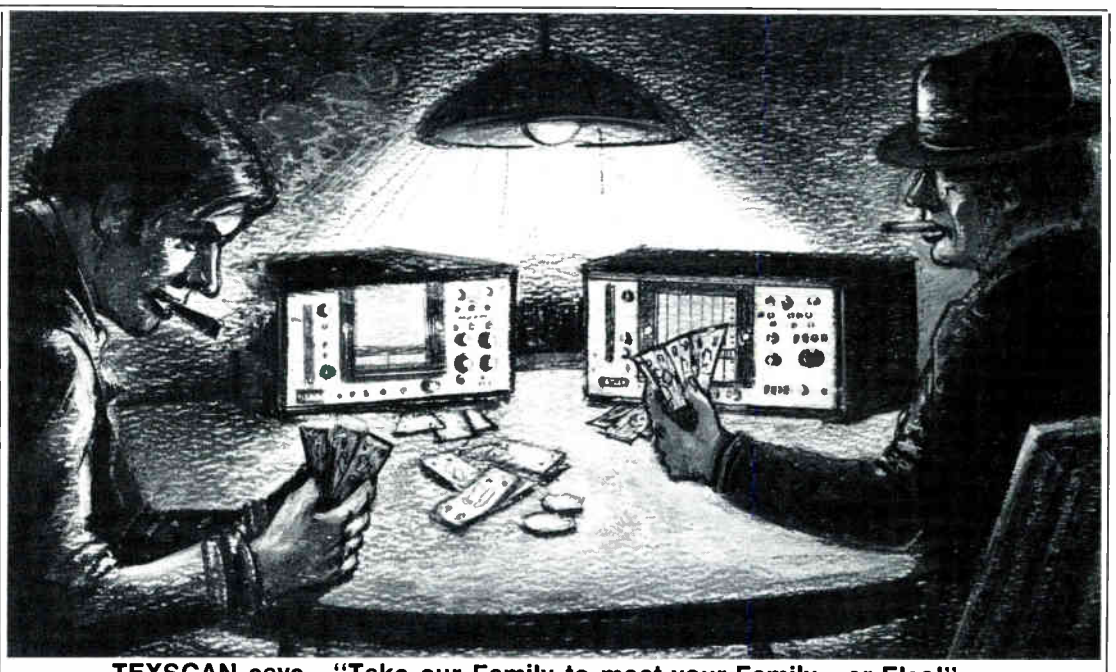

TEXSCAN says—"Take our Family to meet your Family—or Else!"

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TFC-7

Frequency Counter

The tuned frequency counter is wanted for system proof of performance, video demodulation & precise, counted variable marker functions.

This versatile instrument provides both preselector/stripper functions with a broadband 5-300 MHz counter.

Description:
- All channel performance
- 0 dBmV sensitivity
- Accurate
- Variable gate time

Wanted for $1900

VSM-5A

Spectrum Analyzer

The VSM-5A is wanted for complete spectrum analysis requiring phase lock and narrow resolution bandwidths. This instrument is capable of all FCC proof of performance measurements except system flatness.

Description:
- 4-350 MHz
- Crystal markers
- Amplitude calibrator
- −50 dBmV sensitivity
- Battery operated portable

Wanted for $4,250

9550T&R

"Simo" Sweep

The simosweep twins are wanted for precise system alignment and balance.

Description:
- +60 dBmV output
- ±0.25 dB flatness
- Remote triggering

T

- Battery operated
- Long persistence
- Variable frequency marker
- Storage interface

R

Wanted for: "T" $1,095
"R" $2,195

7270

Field Strength Meter

The 7270 is wanted for accurate level measurements. The new (pat. pend.) peak detector and rotary attenuator are identifying marks for this accurate (typically ±0.5 dB) instrument. The Ni-Cad battery provides more than 8 hours use on a charge.

Description:
- 8½" × 13¼" × 8¼" —15 lbs.
- 5-216 MHz
- 10 μV sensitivity
- Rugged construction

Wanted for $895

These instruments have "records" of proven reliability under adverse field environments. They have been on the loose for at least 5 years.

There are other members of the gang, such as frequency counters, sweep generators, oscilloscopes, bridges, attenuators, filters and passive components, as well as distribution amplifiers and passives.

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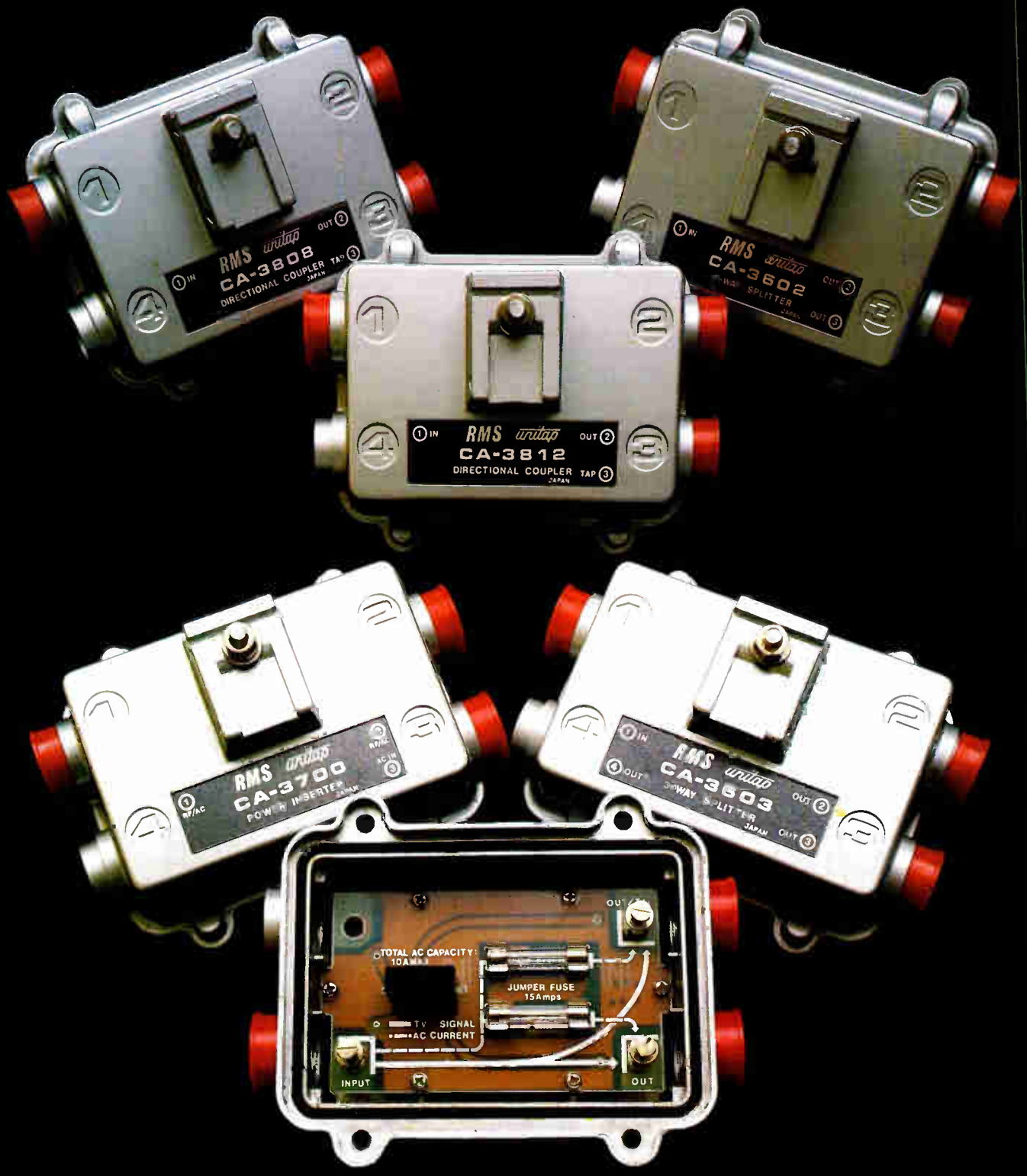

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C-ED News at a Glance

WASHINGTON, D.C.—House communications subcommittee chairman **Lionel Van Deerlin and ranking Republican Lou Frey on June 7 took the wraps off their** long-awaited "top-to-bottom" **revamping of the Communications Act. The rewrite legislation would take all federal controls off cable and hand that responsibility to the states and localities. It would** also **open the door to AT&T and other telcos to provide CATV service.**

All performance standards, signal-to-noise ratio, hum, signal level at subscriber taps (all of what we know as subpart K), **except for signal leakage, would be abolished** on the federal level. See *C-ED* page 23.

Congressmen Van Deerlin and Frey delivering the rewrite news.

WASHINGTON, D.C.—The **FCC has authorized microwave stations in** the cable television relay service **(CARS) to operate continuously.** The commission stated that since the CARS shared the 12.70-12.95 GHz portion of the spectrum with the television auxiliary broadcast service and the similarity of function, equipment and operation of CARS and the other microwave services, continuous operation of CARS microwave stations was warranted. See *C-ED* page 25.

TORONTO, ONTARIO—**Canstar's Advanced Systems Division demonstrated** a **fiberoptics systems** that they have designed and manufactured **for airport applications.** The fiberoptics system, produced for the Canadian Ministry of Transport, will be installed in the Ottawa International Airport for transmission of data from the output of a radar receiver to a Digital Equipment Corp. PDP-11 computer.

NEW YORK, NEW YORK—**Home Box Office has** successfully **completed a swing of its receiving antennas from** the transmission path of **its Satcom II to its Satcom I** spacecraft. In addition, **HBO made a switch of its Mountain and Pacific time zone feeds** from one of its leased transponders (20) to another (22) in order to provide optimum reception. See *C-ED* page 25.

WASHINGTON, D.C.—As reported in May *C-ED*, **the FAA/FCC and** other parties, including **NCTA, are engaged in a research project that may lead to a reexamination of the cable leakage rules.** Phase one will attempt to determine the true relationship between ground measurements and actual interference levels at aircraft altitudes.

OT Laboratories in Boulder, Colorado, developed a "calibrated leak" device that simulates a known cable leak to better understand the cumulative airborne effects of many small ground level leaks. See *C-ED* page 26.

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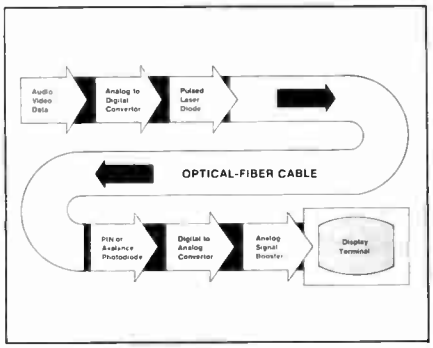

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DEPARTMENTS

OPINION

Cover: July's cover, provided courtesy of Theta-Com CATV, depicts the emphasis of this issue of *C-ED*—power and lightning outages and how to survive them.

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Editor's Letter

This month's issue of *C-ED* presents a series of articles on lightning/power outages we think you'll find not only informative, but just may save you money. Our main stories detail the cause and effect of overvoltages and transients and how to alleviate those situations. These timely articles, provided by GTE Sylvania, CEI Corporation and Theta-Com CATV, begin on pages 15, 27 and 31, respectively. And if those aren't enough, you'll find an interesting article on digital transmission techniques using LEDs and laser diodes in the digital transmission of light-wave signals. And that's on page 11.

On the Washington political scene is the highly controversial "Communications Act Rewrite 1978." You'll find in-depth information about this "hot potato" on page 23, but watch out. This controversial issue could be quite a turnaround for the industry if passed as is.

On a more somber note, we would like to express our deepest sympathies on the death of Don Levenson, founder and president of Wheeling Antenna Company. Don passed away on June 4th, 1978. He was a senior member of SCTE and was very active in industry affairs. A tribute to Don is on page 9.

In this issue, we are introducing a new department for and by engineers called "Out of Sync." Our intention is to provide problems and solutions—simple or highly sophisticated—in a question/answer format.

C-ED has more surprises planned for the upcoming months. Stay tuned for another new department beginning in August.

Paul A. FitzPatrick

Who Doesn't Want to go To Vegas?

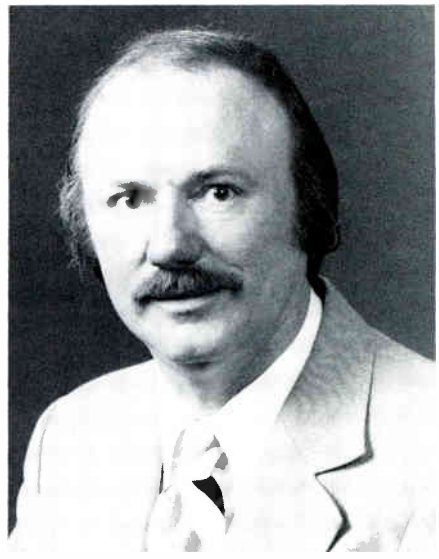
By James A. Luksch
Executive Vice President
Texscan Corporation
Indianapolis, Indiana

I recently read the attendance figures for the 1978 NCTA show in New Orleans, which were compared to those of 1977 at Chicago. There was a significant increase in attendance in 1978. Since New Orleans is by no means easier to reach nor better located to account for this large increase, it seems logical to conclude that the average member of NCTA prefers New Orleans to Chicago. This type of logic may have been employed by the people making the selection of Las Vegas for the 1979 show instead of selecting St. Louis. After all, everyone would prefer spending a weekend in Las Vegas rather than St. Louis. In fact, who doesn't like Las Vegas?

As soon as Las Vegas was announced as the location for 1978, I could hear all the operators screaming hurrahs and all the manufacturers moaning and groaning. It's all in your viewpoint. If you want to pick a place to play—what could be better than Las Vegas, "The best four-day town in the world." But if you want to pick a place to work, Las Vegas is not a very good choice.

Rather than assume that more people went to New Orleans than Chicago because they liked it better, why not assume that more people were "bullish" on CATV in 1978 than in 1977. Also, doesn't anyone remember the Western regional show in 1974 which was held in Vegas? Let me tell you. If you measure the quality of a convention by how much fun you had, then it was a great show. If you measure it by business activity, potential business uncovered, orders closed, time spent with your good customers, etc., it was a disaster.

Don't get me wrong, I like Las Vegas. I've been there many times (always for less than 4 days) and have never failed to have a good time. Mind you, I never went there to work. If I go to the NCTA show this next year, I'm sure I will enjoy it again. I'll be able to enjoy it because there will be so few customers in the exhibit hall that we will be able to cut way down on the required booth duty so I'll be able to get some rest during the day in preparation for each new evening's onslaught on the Strip!



Illinois/Indiana and SCTE Host Two-Day Seminar

CHAMPAIGN, ILLINOIS—The Illinois/Indiana CATV Association and the SCTE conducted two days of intensive technical programming June 6-7 at the University Inn Hotel, Champaign, Illinois Registration was highly successful, with over 140 attendees

The first day of the seminar covered cable basics Wallace Hooks of Courier and Hooks, spoke on mapping, make-ready and pole changeouts The next session was on system performance specifications, by Richard Covell, GTE Sylvania Frank Ragone of Jerrold Electronics spoke on distribution electronics, and Keith McIntosh from LRC Electronics gave a talk on cable connectors The luncheon address was presented by Robert Luff, vice president of engineering for NCTA, on the importance of education and training

The afternoon covered the following topics: cable selection—trunk, feeder and drop, by Dean Taylor and Mac Qurashi from @CS Hatfield; overhead and underground construction by Gordon Carpenter of Antenna Specialties; house drop installations, Gordon Carpenter and drop connectors by Keith McIntosh.

Dan Yost of Compucon gave some insight into frequency coordination and field surveys.

A hospitality suite held the first evening featured a demonstration of SCTE's new cassette color tape, "Diagnosing Common Cable Television System Faults."

The second day's morning session covered site acquisitions and antenna selections by John Schuble, Telesis Corporation; frequency coordination and field surveys by Dan Yost, Compucon; earth station electronics by Danny Coronet, Scientific-Atlanta; and earth station construction by Jim Hurd, Farinon Electric

The afternoon was devoted to transmission via FM microwave, by Duke Brown, Microwave Associates; FM transmission via coaxial cable by Dick Old, CATEL; transmission by optical fibers, Sol Yeager, Times Fiber; and transmission via video lines by John Woods, General Cable Corporation

This seminar, reported to be an outstanding success, was due to the efforts of Bill Ellis, SCTE director for the Indiana CATV Association; Barry Wilson, GTE Sylvania; Shirley Watson, executive secretary of the Illinois/Indiana CATV Association; and Tom Jokerst of Continental Cablevision These were the committee members that made this seminar the success it was

Tribute to Don Levenson

PITTSBURGH, PENNSYLVANIA—Donald W. Levenson, founder and president of Wheeling Antenna Company, Inc., Wheeling, West Virginia, passed away on Sunday, June 4th. He was 58 years old.

Levenson, a professional engineer, developed the simultaneous sweep used by CATV operators nationwide. He also founded the Wheeling Antenna Company in 1952. Wheeling Antenna Company is a sustaining member of SCTE.

Well-known in the cable industry, Levenson was active in SCTE and industry affairs in general. He was a senior member of SCTE, a member of the IEEE, and the first recipient of NCTA's Outstanding Technical Achievement Award.

Services for Levenson were held Tuesday, June 6th, in Pittsburgh, Pennsylvania. He is survived by his wife Ethyl, two sons Marc and Jon, and a grandson.

Central-Atlantic Chapter of SCTE and NJCTA to Meet

NEW YORK, NEW YORK—On Friday, August 11, the Central-Atlantic Chapter of the SCTE will sponsor the technical portion of the New Jersey Cable Television Association meeting scheduled for August 9-11

The program will consist of a series of panels covering such diverse areas as Grounding and Bonding, Fiberoptics-Revisited, Addressable Pole Line Hardware and Fire Alarms.

Included in the day's activities will be a preview of the SCTE technical training tape, "Diagnosing Common Cable System Faults," which was produced cooperatively by the New York State Commission on Cable TV and the SCTE

New England Chapter and The NECTA

PORTSMOUTH, NEW HAMPSHIRE—The annual New England Cable Television Association meeting will be conducted this month, July 9-12, at Wentworth-by-the-Sea, in Portsmouth, New Hampshire The SCTE New England chapter will be working with NECTA executive director Bill Kenny in putting together an effective program for the meeting

Tuesday July 11 will be dedicated to technical programming Chapter president Bill Hinton will work with Kenny to assure the success of the meeting

Ad Index

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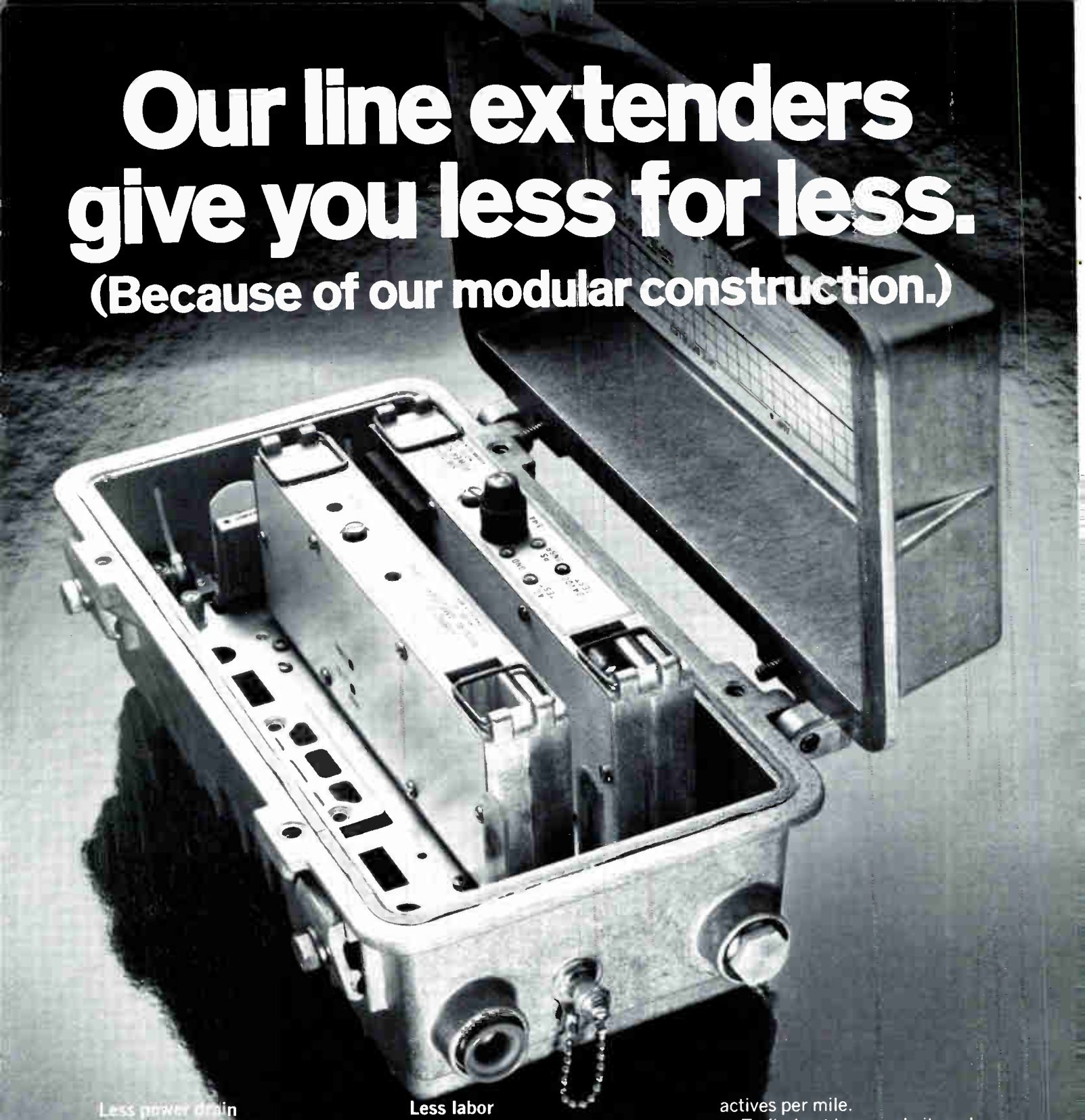
(Because of our modular construction.)



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SYLVANIA | GTE

Digital Transmission of Light-Wave Signals

By Wm. N. Redstreake, vice president
Winchell Marketing Communications

Audio, video and data . . . plus digital transmission techniques . . . add noise-free transportation over glass fibers in 50-million or even 100-trillion cycle per second pulses, generated by light emitting diodes or by injection laser diodes.

Another avenue for broadband telecommunications. Another miracle, ready for acceptance. Another opportunity . . . for the cable industry.

Today, new techniques are available to make early dreams of the wired nation as accurate and reliable as a ten-mile long, underwater cable drop. Even old Ma Bell is finally doing something with commercial evaluations of light-wave communications for telephone-plus service.

In the spring of 1977, Bell installed a 1.5-mile light-wave communications system—for audio, video and data—to interconnect two switching offices and a large commercial building in Chicago's center-city business district.

For that "telephone-plus" installation, signals are dispatched over a one-half-inch diameter cable, consisting of 24 glass fibers. The information capacity of each fiber is 44.7 megabits per second. This means the light source feeding information into the optical cable can be turned on and off, or pulsed, 44.7 million times each second.

At that 44.7-megabit pulse rate, each of the 24 glass fibers can handle almost 700 individual voice signals. The 24 fibers, arranged in two bands of 12, have a capacity of 12 times 672 or 8,064 two-way

telephone conversations: All within a half-inch-diameter optical cable.

Multiply by Two Million

If a semiconductor laser diode, with a frequency of 100 terahertz—that's 100-trillion cycles per second—served as the light source, Bell's 24 glass fibers could, in principle, simultaneously carry more than eight-billion two-way telephone conversations.

And that same potential ultra-wide bandwidth exists for the cable industry, just waiting to be tapped.

By utilizing only a very small portion of the ultra-wide bandwidth of infrared and near-visible light, several hundred or even several thousand television channels plus 100-million or more two-way telephone conversations could be transported over those 24 little strands of optical fiber. Furthermore, data communications for industrial, commercial and consumer applications—including applications not yet envisioned—could be handled noiselessly with just another very small portion of the same bandwidth.

(For a general description of the laser, refer to the October '77 issue of *C-ED.)*

The semiconductor laser with a tightly controlled narrow beam of 20 degrees and a 100-THz bandwidth—that's 10^{14} or 100-trillion cycles per second—may be the ultimate pulse source for optical fibers.

Water-vapor lasers could be used for the spectral range between microwaves and infrared. But lasers (and there is a wide range of working laser configurations, some as small as a grain of sand) aren't the only pulse sources available for efficient fiberoptic cable systems.

Visible and Near-Visible Light

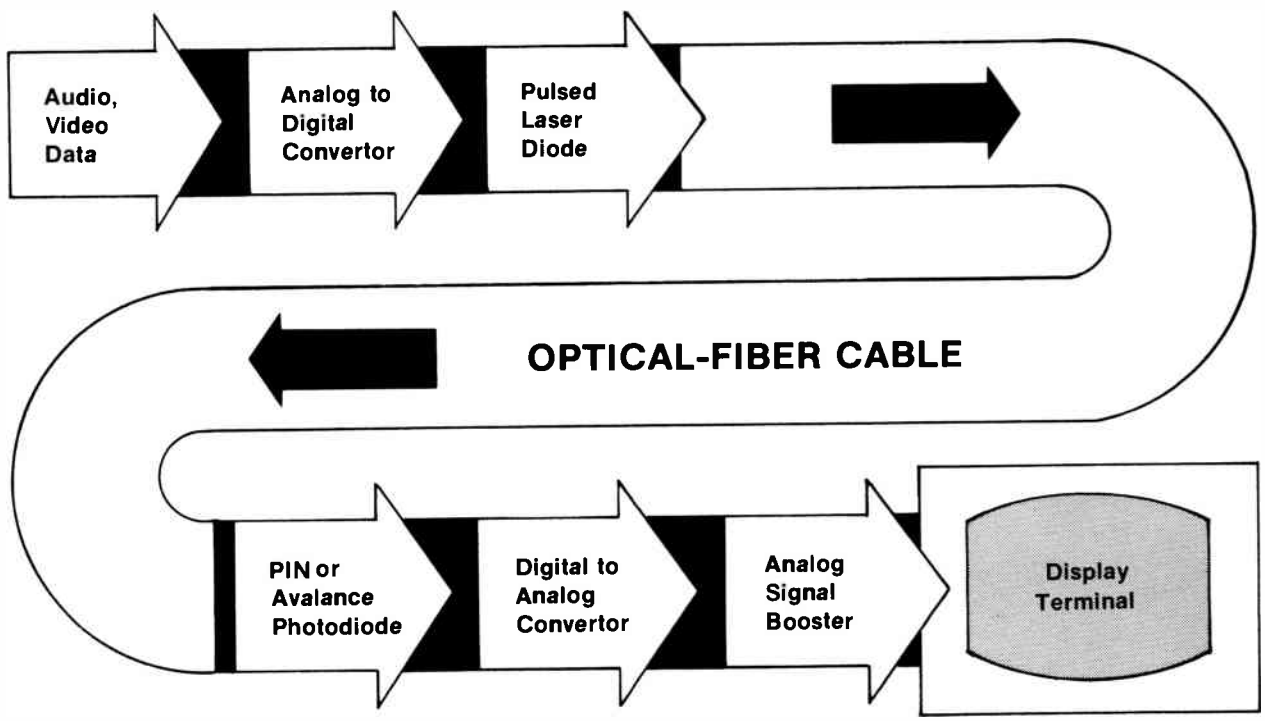
The high-intensity Light Emitting Diode—that's the LED in your watch or pocket calculator—has been used to transmit noise-free, visible-light signals through optical fibers. The IRED (InfraRed Emitting Diode) lifts the frequency range into the near-visible bandwidth.

Like most broadcast signals, light-wave communications can be implemented via "conventional" analog techniques by superimposing signals on continuous energy waves to modulate the amplitude of energy entering the optical fibers.

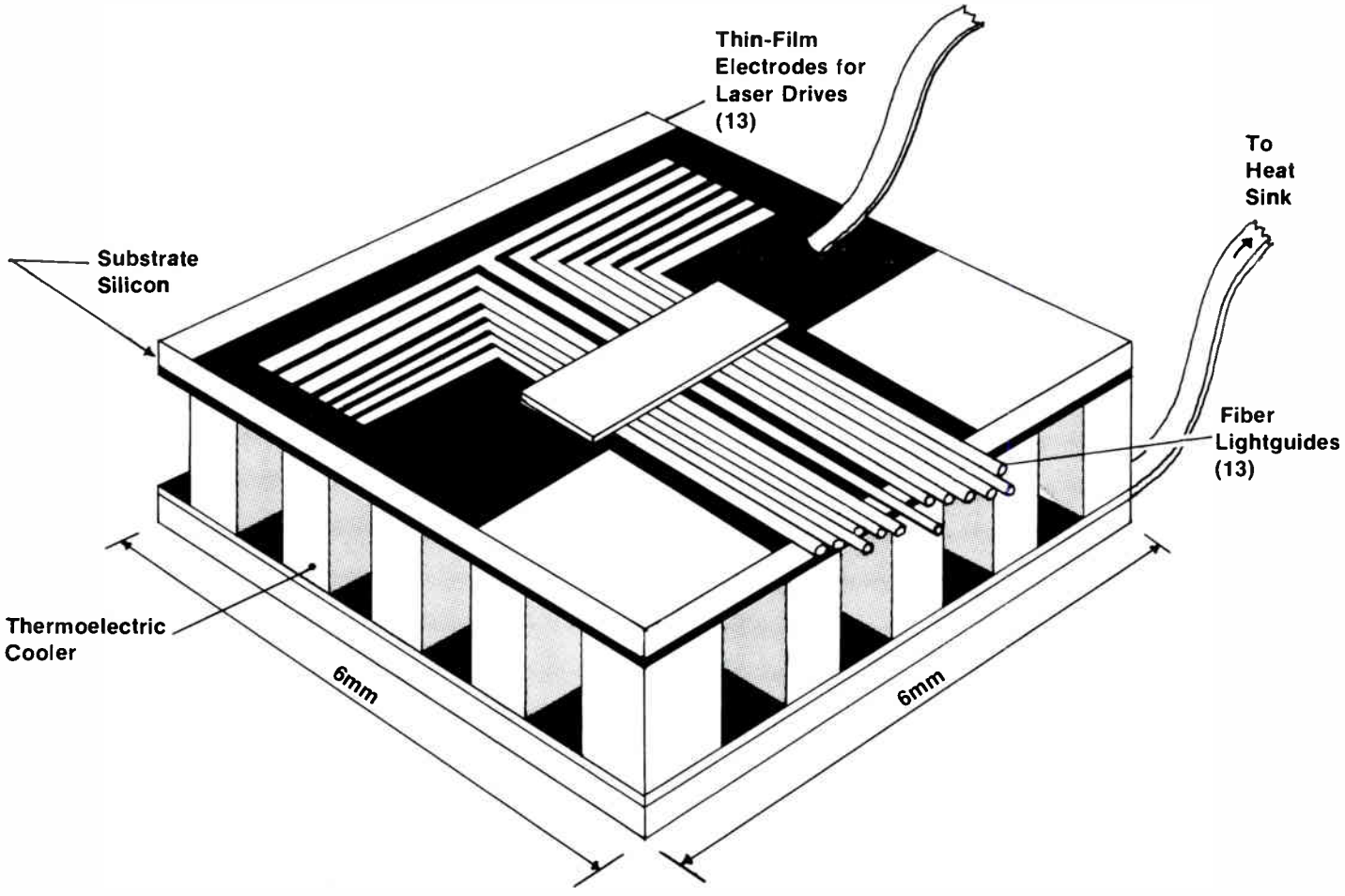
Although such ultra-high-frequency pulse-generating equipment will function in gigahertz and terahertz ranges, the analog technique of merely superimposing audio, video and data onto those ultra-high-frequency continuous waves is analogous to conventional broadcasting . . . at least in principle.

The chief drawback of any analog transmission system, including most of today's AM/FM/TV broadcasts, is that if the amplitude-modulated signal is distorted in any way during its passage through air (or through an optical fiber with appropriate "amplifiers"), that distortion will be superimposed on the signal received and amplified for the listener or viewer.

Digital Transmission of Pulsed Light-Wave Signals for One-Way Cable System



Since digital pulses are either present or absent—no in-between condition can exist—they can be detected with an extremely low probability of error. Hence, digital transmission of pulsed signals allows long supertrunk runs.



Integrated package contains all electronic and optical elements of 13 fiberoptic transmitters. This single-chip package, developed by IBM, includes a semiconductor laser array, a cylindrical silicafiber lens (130-micron diameter), and an array of fiberoptic light guides. The entire package is only half-thumb size!

Digital Coding

As the broadcast industries have recently discovered, a very effective technique for transporting distortion-free signals is to convert those analog signals to digital form, prior to transmission.

Essentially the analog-to-digital (A/D) conversion is accomplished by sampling the amplitude (height) of the continuous wave at regular intervals. For optimum results, the wave must be sampled at twice the rate of its highest frequency. Then, binary-type pulses (analogous to the basic binary system employed for electronic digital computers) are transmitted, according to a pre-established programmed code.

With a suitable receiver, the binary pulses are detected and decoded with D/A converters to reconstruct the original wave.

The main advantage of digital transmission over the air or through fiberoptic cables is a very significant improvement in the signal-to-noise ratio. Since the digital pulses are either present or absent, they can be detected with an extremely low probability of error. Hence, digital transmission gives weak signals one helluva powerful helping hand.

And with no more inherent carrier-to-noise problems, you can say goodbye to expensive heterodyne and superheterodyne processors.

Technology Exists

The Bell system presently uses digital transmission techniques to send voice signals over cable or microwave. Eventually, Bell will get around to adapting digital coding to light-wave communications.

Will the cable industry sit back while Bell surges ahead . . to leave a few adventuresome CATV leaders with fond memories of Teleprompter's point-to-point breakthrough in fiberoptic communications?

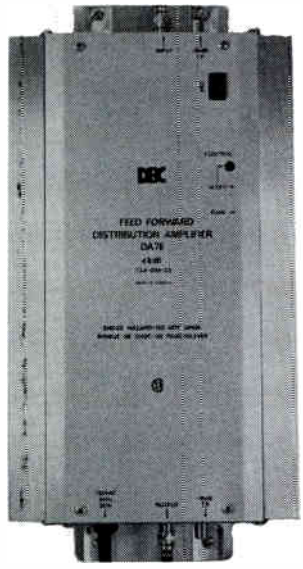
Or will some far-sighted manufacturers of yet-to-be-unveiled optical-cable equipment lead the way to new horizons in communications . . with viable products such as IREDs, pulsed lasers, PIN photodiodes and "avalance-type" photodiodes for transmission and reconstruction of ultra-dependable digital light-wave signals? **C-ED**

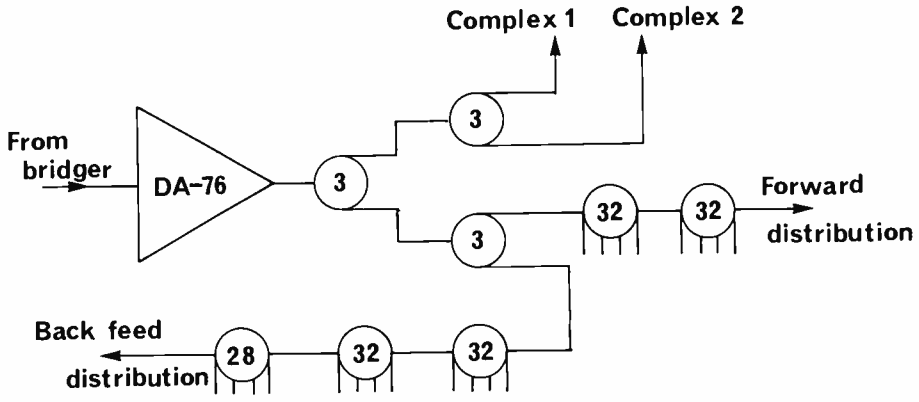
How Wide is a Laser's 100-THz Bandwidth?

Bandwidth	10^N Power	Cycles per Second
one kilohertz (kHz)	10^3	1,000
one megahertz (MHz)	10^6	1,000,000
one gigahertz (GHz)	10^9	1,000,000,000
one terahertz (THz)	10^{12}	1,000,000,000,000

Hence, a laser diode with a controlled narrow beam of 20 degrees and a 100-THz frequency (10^{14} or 100-trillion cycles per second) will produce a bandwidth that is more than 300,000 times wider than the present 300-MHz bandwidth in use by the most modern CATV systems.

NEW CABLE SYSTEMS CAN USE FEWER LINE EXTENDERS AND SAVE MONEY BY USING OUR DA-76 FEEDFORWARD DISTRIBUTION AMPLIFIERS!





use indoors to feed apartments, condominiums and cable distribution

DA-76	**20 dB**	**$250**
	40 dB	**$300**
	52 dB	**$330**

This ultralinear amplifier, specially designed for large apartment complexes, outperforms four traditional amplifiers at less cost. System noise, triple beat noise, 2nd order and cross modulation distortion remain unimpaired on 35 channel systems at +54 dBmV output levels. Splitting the DA-76 output four ways can provide sufficient feeders to service large apartments as well as street drops. Forward and back-feeding conventional distribution lines can save on line extenders and simplify powering needs.

DA-76's high efficiency switching regulator power supply means fewer watts and lower running costs. Two way facilities are available. 30, 60, 120 and 240 VAC power options are available. Proven reliable in the field, the 20 dB unit has a calculated MTBF of 17 years. The housing consists of a die-cast and extruded aluminum box frame, which provides solid grounding and excellent heat sinking facilities. The rear cover plate provides easy wall mounting and access to internal fuses.

- 3000' OF DISTRIBUTION PLUS TWO APARTMENT COMPLEXES. NO LINE EXTENDERS AND ONLY ONE APARTMENT AMPLIFIER
- FEWER AMPLIFIERS PER SUBSCRIBER FOR RELIABLE SERVICE
- REDUCED OVERALL POWER CONSUMPTION FOR LOWER OPERATING COSTS
- 20, 40 & 52 dB GAIN OPTIONS
- SOLID 35 CHANNEL PERFORMANCE
- POWER SUPPLY OPTIONS AVAILABLE
- RELIABLE FIELD TESTED DESIGN
- TWO WAY FACILITIES AVAILABLE
- LOW NOISE FIGURE AND VERY LOW DISTORTION AT HIGH OUTPUT LEVELS MAKE THE DA-76 ON ITS FIGURE OF MERIT CATV'S No 1 AMPLIFIER
- OTHER APPLICATIONS? TRY HIGH LAUNCH FROM THE HEADEND

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call sue ashton

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Protecting CATV Transmission Equipment From Surges

By Robert A. Sherwood,
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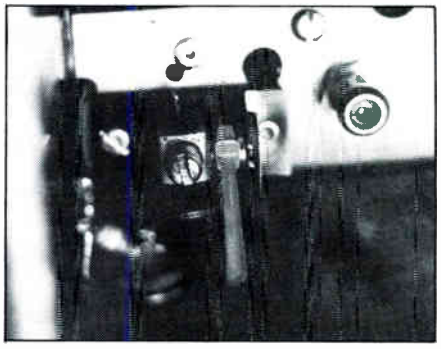


Figure 1 - surge arrestor mounting

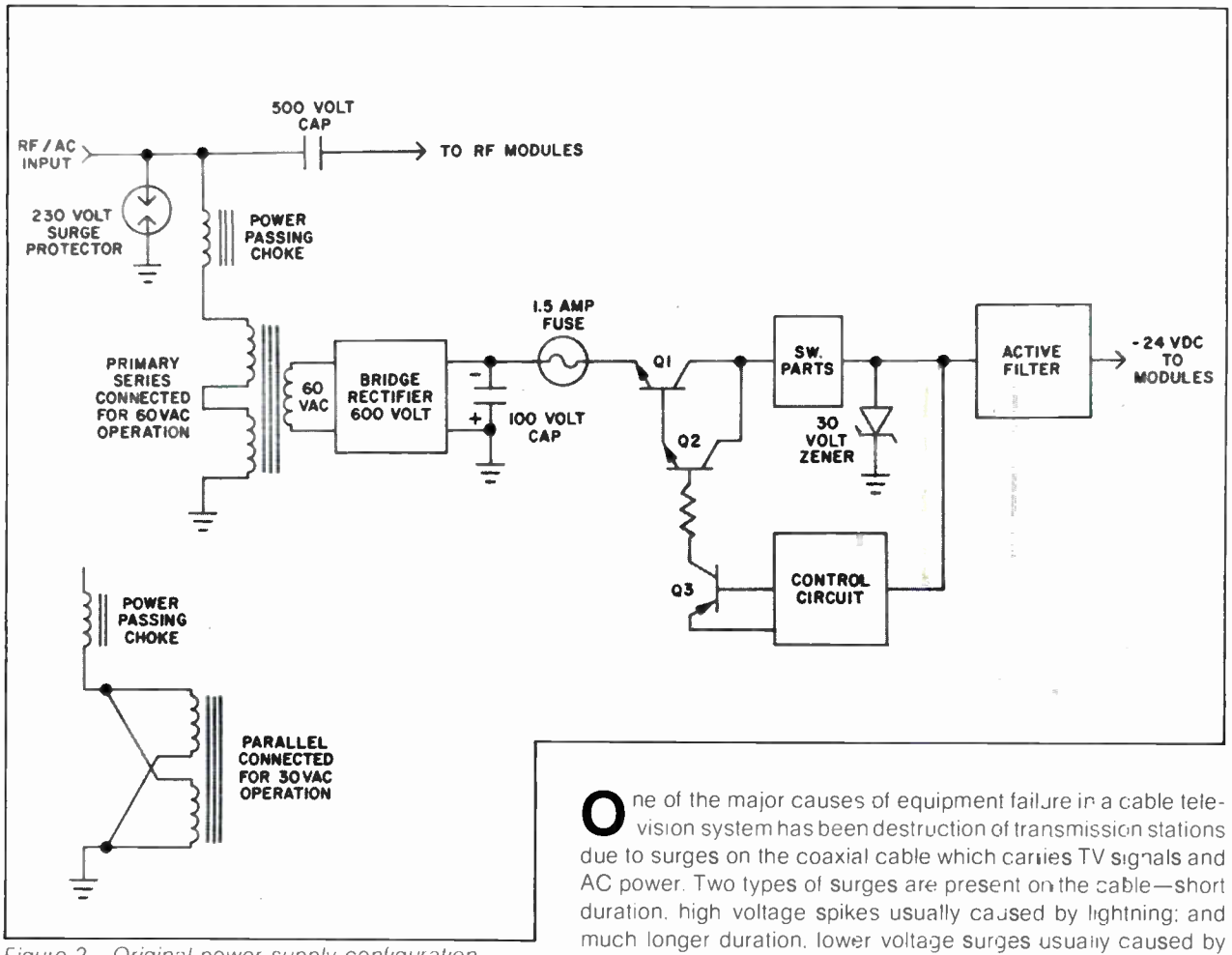


Figure 2 - Original power supply configuration

One of the major causes of equipment failure in a cable television system has been destruction of transmission stations due to surges on the coaxial cable which carries TV signals and AC power. Two types of surges are present on the cable—short duration, high voltage spikes usually caused by lightning; and much longer duration, lower voltage surges usually caused by transients on the utility power system. This paper discusses the causes of these surges and describes an inexpensive technique for preventing station damage when they occur. Included is a history of field experience which led to a successful incorporation of this technique into thousands of miles of CATV plant.

One common device used by most CATV equipment manufacturers to protect amplifiers is the gas filled, spark gap. This device is utilized because it has a very high impedance and can be connected directly across the coaxial cable without disturbing the signals being carried. When the voltage across the cable exceeds the breakdown voltage of the gap, it fires and prevents any further increase. Typical breakdown ratings of CATV devices are 90, 145 and 230 volts.

When choosing the optimum breakdown voltage to use in protecting equipment, the natural tendency is to pick the lowest value which doesn't fire under normal operating conditions. The problem with this approach is that the gaps can be damaged by

repeated firing and the chances of firing increases with lower breakdown voltage. A better way to choose the breakdown rating is to determine how high a voltage can be safely tolerated by the equipment and use the next lower standard value.

Even when a 230 volt device is used in a CATV system, damage to the protector can occur. It is therefore important to locate the device so that it can be easily removed for inspection or replacement.

The amount of current that results from a lightning surge is quite large, causing significant voltage drop in very small impedances. Any leads in series with the surge protector should be kept to a minimum since the voltage developed across the lead impedance adds to the breakdown voltage. A wired in gas discharge device with 1/2-inch leads on either side has lost a large percentage of its effectiveness under fast rise time surge conditions.

The configuration[1] shown in Figure 1 incorporates all of these features. The surge arrestor is a leadless type located next to the cable seizure assembly and uses wide low resistance straps that are bonded directly to ground. The spark gap snaps in between the seizure assembly and the ground strap. A nylon pull strap allows easy removal for inspection and replacement. The gap breakdown voltage is 230 volts and lab tests as well as field experience indicate that no station components are damaged when short duration surges are limited by this device.

All surges, however, are not of short duration, but fortunately longer duration surges tend to be at a lower voltage. Protection against surges that are lower than the breakdown voltage of the gas discharge device will now be discussed.

[1] United States Patent No. 3,659,153, 25 April 1972. *Clamp with Surge Protection*, Ralph Neuber, Assignee GTE Sylvania Inc.

Long duration surges can be prevented from entering the amplifier modules with a capacitor having a breakdown voltage greater than the rated gas gap voltage and a low enough impedance above 5 MHz to pass the desired signals. Protecting the station power supply is a much more complex problem. Field experience shows that long duration transients are responsible for more station power supply failures than any other cause.

For safety reasons, all CATV systems are bonded to utility power company grounds. This prevents a difference in potential between CATV and utility grounds that could be hazardous to the health and well-being of any pole climber. The resistance of the coaxial cable sheath between bonded areas is of the same magnitude as the utility company's ground wire. This causes a significant portion of the ground current to be carried by the coaxial cable creating a voltage drop. The voltage drop can add to the AC voltage at an amplifier station, thus creating a higher input voltage than exists at the AC power supply which may be several poles away. Under fault condition, for example, when there has been a power failure and power is restored, the ground currents can be quite high until all surge currents have decayed.

Several techniques have been used to combat this type of transient. One is an electronic crowbar that shorts the line very quickly and thus protects the power supply from both long and short duration surges. If the crowbar is used in conjunction with a fuse, protection against a short spike is quite effective but a long transient will blow the fuse and cause an outage. If no fuse is used and the surge is long enough, the crowbar circuit will overdissipate and burn out removing protection so that later surges will damage the equipment. A thermal circuit breaker could be used instead of a fuse but it is slow acting and could still overdissipate the crowbar circuit. A crowbar with sufficient power handling capability to overcome this problem is expensive

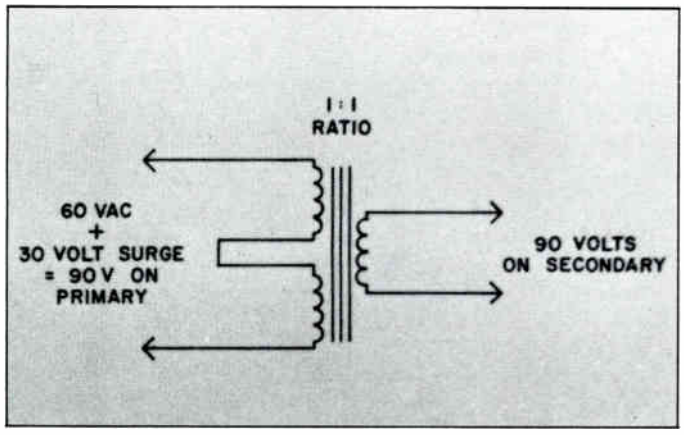


Figure 3A. - 60 volt configuration

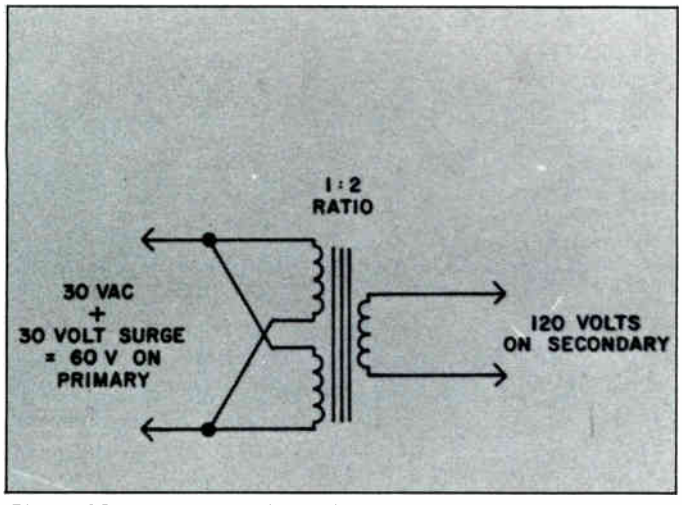


Figure 3B. - 30 volt configuration

The conventional approach of adding external devices was abandoned and attention turned to upgrading the power supply to allow safe operation with all input voltages up to the saturation point of the transformer. It was noted that the power transformer saturated at approximately twice the rated input voltage. This is true for both 30 and 60 volt configurations. The maximum secondary voltage that could occur with a square wave input is therefore 120V peak. Under this condition the filter capacitor sees about 117V DC. The filter is rated at 100 volts but can easily tolerate a surge of 117V for a short time and field history has verified its tolerance. By increasing the breakdown voltage of one more transistor in the supply, safe operation up to transformer saturation was achieved. Of course the presence of excess voltage for an extended period of time could cause overdissipation resulting in a failure. Only field history could determine how serious a problem remained.

As added insurance, the active filter at the output of the switching regulator was modified so that it became a regulator when the supply output began to exceed a safe level. In order to allow the active filter to regulate, the overvoltage zener diode was moved to the output of the active filter.

In the process of making these changes, it was decided to add a fuse to the primary of the power transformer. The fuse is a slow blow type and is rated to blow when transformer damage is imminent. This prevents the transformer from oozing its contents over the inside of the station in the event of an extremely long surge.

Figure 4 is a block diagram of the completely modified surge protection system now widely in use. It shows a simple cost effective power supply capable of reliable operation in the hostile cable television environment. The supply utilizes the natural tendency of the power transformer to limit voltage through saturation combined with high breakdown rated parts that handle the saturation voltage without damage. Since these improvements have been incorporated, thousands of miles of plant have been built in many geographical locations with no power supply problems reported. One amplifier station has been operating without failure for eight months in a location that previously produced a failure on the average of once every three to six weeks.

Another technique is to change the taps on the station's power transformer to keep the secondary voltage within safe limits. This can be done with solid state devices and works well. The only disadvantage is the complexity of the circuitry and its attendant cost. The simpler approach discussed here is the result of extensive efforts in both the laboratory and in actual working systems and was implemented in stages over a period of years. Each stage resulted in fewer reports of power supply failure to the point where such reports are rare.

The original power supply configuration was as shown in Figure 2. A gas discharge surge protector limited surges to 230V as discussed earlier. The coupling capacitor prevented the long duration AC surges from entering the RF amplifier. These two devices effectively protected the RF amplifier and the short duration, high voltage surges caused only minor problems with earlier discrete device amplifiers and no problems with later hybrid IC amplifiers. In fact this configuration protected the modules (and power supply) from a surge produced by discharging a four mfd capacitor charged to 8,000 volts into the station ports. This surge results in a peak current of 5,000 amperes. The AC was picked off the input line and routed to the

power transformer. The primary windings of the transformer were connected in series in a 60 volt system and in parallel in a 30 volt system so that, at maximum system voltage, 60V always appears on the secondary. The bridge rectifier had a 600 breakdown rating and was quite reliable. The filter capacitor was rated at 100 volts and was also quite reliable. After the filter, a 1.5 amp fuse was placed in series with the line which was used in conjunction with a zener diode for overvoltage protection. The zener diode, located after the series pass transistor, was used to prevent damage to the station modules in the event that the power supply voltage attempted to exceed a safe value. Excess current flowed through the zener and the fuse would blow. This protection circuit also worked well and prevented module damage in the event of runaway power supply voltage, although it sometimes destroyed the series pass transistor and the zener while saving the station modules.

The series pass transistor had a 200 volt breakdown rating and, except when damaged by the overvoltage circuit, it was also quite reliable.

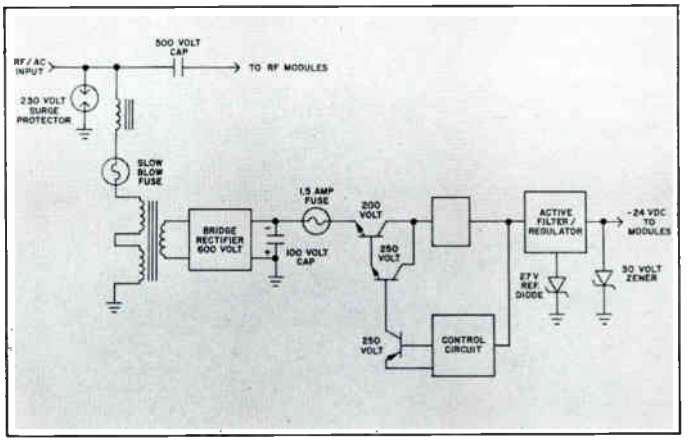
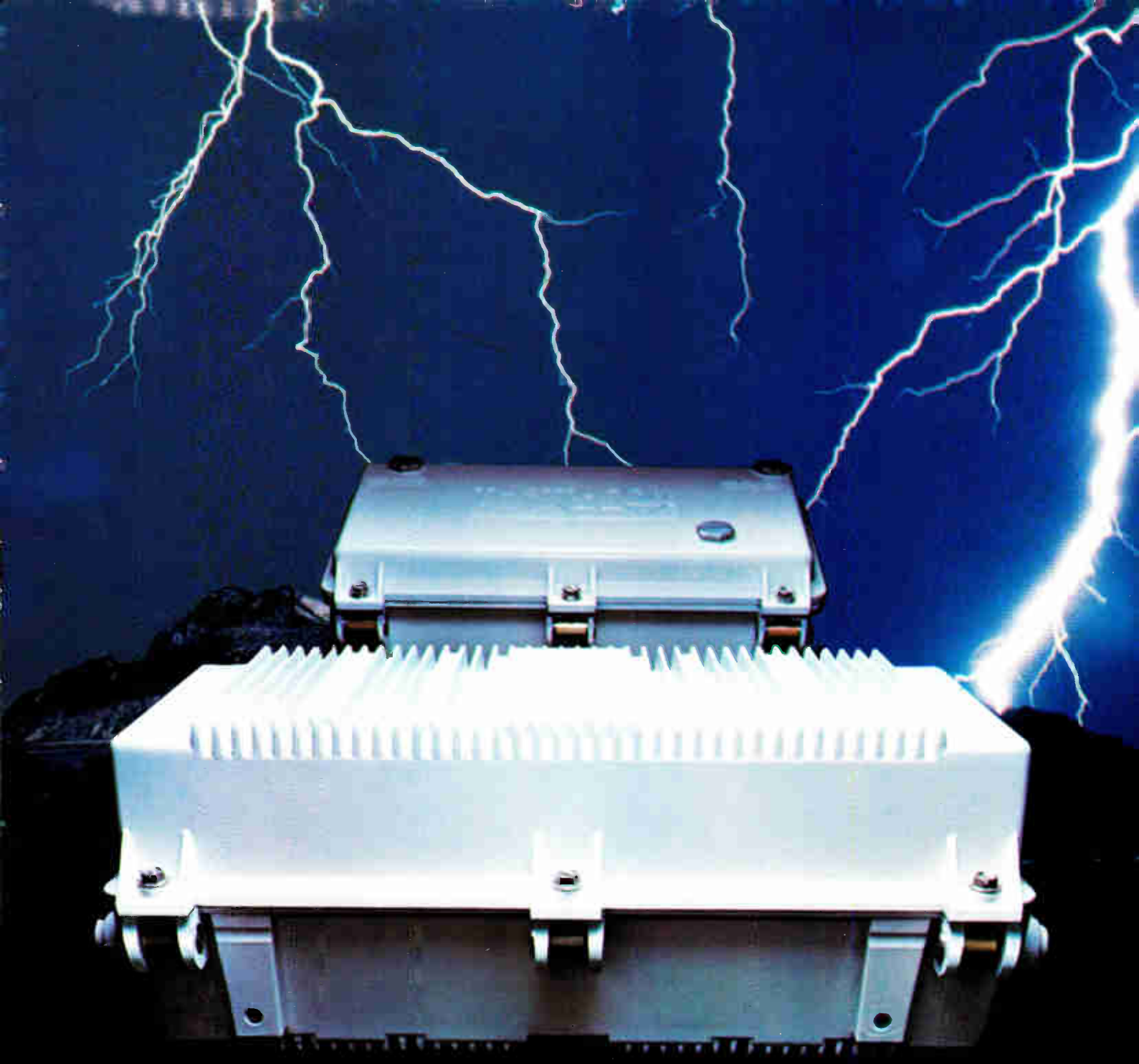


Figure 4 - Improved power supply configuration

As the result of reports of some power supply failures in the field under exceptional surge conditions, some additional improvements were made. The first improvement was to increase the breakdown rating of the transistor driving the series pass transistor from 80V to 250 volts. This change almost completely eliminated failures in 60 volt systems but failures were still occuring in some 30 volt systems. To understand why, refer to Figure 3 and note that a surge of 30 volts on a 30 volt system results in 120 volts on the secondary of the power transformer since the transformer is wired to provide a 2:1 step up. In a 60 volt system, a 30 volt surge results in only 90 volts on the secondary. If, for example, sheath currents were the cause of the surge, the likelihood of a 30 volt transient would be the same in both 30 and 60 volt systems. Thus higher secondary voltages would be present in a 30 volt system and more failures expected.

After this change was made, effort centered on one cable system located in South Carolina which was experiencing frequent failures with various manufacturers' equipment. A series of add-on protection circuits were tried and proved to be inadequate. An additional regulator was placed ahead of the bridge rectifier which began regulating the input voltage when a safe level was exceeded. The surges were of long enough duration and of such a level that the regulator overdissipated and shorted, rendering it useless. An 80 volt metal oxide varistor was placed across the secondary of the power transformer. A few weeks later two power transformers were returned that resembled lumps of charcoal. The remainder of the power supply was saved but an outage still occured and parts were damaged.



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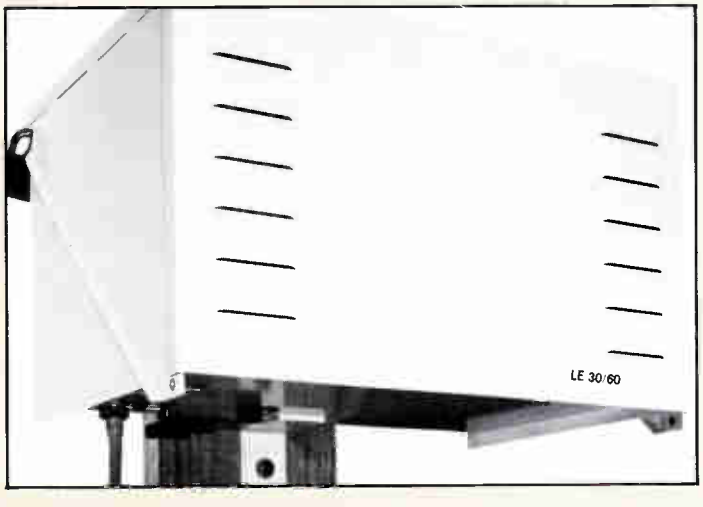

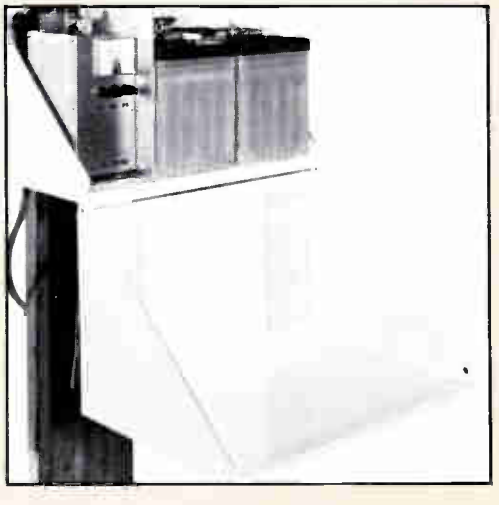

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Proposed Communications Act Rewrite 1978

WASHINGTON, D.C.—The highlights of the proposed Communications Act Rewrite 1978 spotlights reorganization: it would abolish the FCC as we now know it and replace it with a Communications Regulatory Commission. It's fundamental charter would be that regulations should be necessary only "to the extent marketplace forces are deficient."

The new Communications Regulatory Commission would set up a national telecommunications agency as an independent policy-making arm of the Executive branch, replacing the national telecommunications and information administration in the commerce department.

In cable TV, the proposed Rewrite would essentially prohibit the federal regulation of cable television. All performance standards, signal-to-noise ratio, hum, signal level at subscriber taps (all of what we know as subpart K), except for signal leakage, would be abolished. These standards would then be under the jurisdiction of the individual states.

In the common carrier area, it would permit common carriers to become engaged in telecommunications of all kinds.

The proposed Communications Act really concentrates on broadcasting, cable and common carrier, with some reference to public telecommunications. Under broadcasting, it would deregulate radio, and licenses would be for an indefinite term, subject to revocation only for violations of technical rules. It would extend television licenses from three to five years.

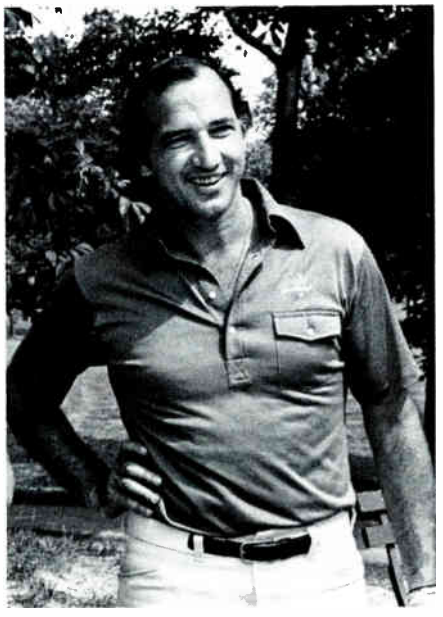
The new Act would establish a license fee that would reflect both the cost of processing the license application and the value of the spectrum occupied by the user. This applies to broadcasting and non-broadcasting services, such as the CARS facilities.

A telecommunications fund would be established with the license fees collected. This fund would support the Communications Regulatory Commission as well as new public broadcasting, minority ownership of stations and the development of telecommunications services in rural areas.

Schmidt Responds to Proposed Rewrite

In response to the proposed Rewrite, NCTA president Robert L. Schmidt stated: "We applaud the efforts of Congressmen Van Deerlin and Frey in attempting to develop an updated, consumer-oriented communications act. The major provision of the bill would lift the federal regulatory shackles which have long denied customers the full benefits of cable television technology. If current federal deregulations, as proposed in the bill allows cable systems to offer new signals and services in each marketplace, the viewer will benefit. However, to assure that regulation is dismantled on the federal level, and would not be reassembled on the state level, some congressional guidance would be necessary. The public deserves a guarantee at the national level of the broadest possible variety of communications services. We also believe the bill's common carrier provisions must be carefully scrutinized. They appear to open the door for the world's largest and most profitable monopoly, the telephone company, to expand into virtually all communications, including cable television. We look forward to the hearings on this new proposal, where the need for these modifications can be explored in depth."

A series of hearings on the proposed Rewrite (whether fragmented into broadcasting, cable, etc., or the entire Rewrite) are scheduled for the near future.



Robert L. Schmidt, NCTA president

FCC Won't Support Goldwater/Vanik Bill

WASHINGTON, D.C.—In an informal fourth redecision, the FCC was reluctant to support the proposed Goldwater/Vanik Bill scheduled for hearings around June 15. The bill addresses the rising interference complaints on consumer electronic products by expanding the commission's regulatory powers to virtually all electronic products capable of receiving interference.

The bill would enable the commission to require, for example, RFI suppression devices on TVs, stereos, phonos, PA systems, etc., as well as conspicuous labeling of product RFI susceptibility.

While all expressed concern over the rising interference cases, the majority of the commission felt they could not support the bill in its present form due to costs, complexity and present lack of suitable RFI standards and measurement equipment.

The commission indicated, in its June 8th meeting, that it preferred as an alternative the reliance on consumer pressure to bring about manufacturer's changes. It said many firms have voluntary programs underway to reduce RFI to its products and the commission would support a consumer awareness and education program to provide catalysts for

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Continuous Operation of CARS Microwave Stations Granted

WASHINGTON, D.C.—The Federal Communications Commission has authorized microwave stations in the cable television relay service (CARS) to operate continuously.

Continuous operation means a station can transmit 24 hours a day, even when no information is being relayed. The previous rules permitted operation only when information was available for transmission.

The change was proposed February 8, 1978, to achieve improved reliability and stability of the microwave equipment. The FCC noted that in its decision (Docket 20539) allowing continous operation of these stations, it had cited the improved reliability and frequency stability of present-day microwave equipment and the contribution to component failure introduced by intermittent operation.

The commission said in view of this and the fact that the CARS shared the 12.70-12.95 GHz portion of the spectrum with the television auxiliary broadcast service and the similarity of function, equipment and operation of CARS and the other microwave services, continuous operation of CARS microwave stations was warranted.

This action becomes effective July 14, 1978.

HBO Affiliates Make Successful Swing from One Satellite to Another

NEW YORK, NEW YORK—Two and a half months of careful preparation enabled more than 250 earth stations serving HBO pay-TV affiliates to successfully complete a swing of its receiving antennas from the transmission path of one RCA American Communications domestic satellite to another. The earth stations involved serve more than 350 HBO cable affiliates in 45 states.

The intricate game of astral hopscotch implemented an RCA Americom decision to move all cable TV services from its Satcom II to its Satcom I spacecraft and began officially at 6:00 a.m. EDT, June 1.

Although both satellites are in geosychronous orbit approximately 22,300 miles above the equator, they are separated by 16 longitudinal degrees. In addition, HBO made a switch of its Mountain and Pacific time zone feeds from one of its leased transponders (20) to another (22) in order to provide optimum reception.

In mid-March HBO issued the first in a series of extensive technical advisories to its affiliates. Each earth station operator was individually informed of anticipated conditions following the switch to Satcom I—signal strength, antenna orientation, sun outage tables and other technical parameters—tailored to the specific equipment the operator had installed and the precise antenna site.

On April 1, through a special arrangement with RCA, HBO began a two month period of test transmissions on three transponders of Satcom I to allow affiliates to do preliminary swings to check on possible sighting problems. In addition, HBO's signal was duplicated on both satellites for a two week period following the official switch. Almost everyone who conducted preliminary tests were able to resolve problems. A few who could not because of manpower or other reasons were protected by the period of duplicate transmission.

HBO plans further signal testing to enable some earth stations to "fine tune"

and complete cross-polarization requirements.

Signal Leakage Status

WASHINGTON, D.C.—As reported in May *C-ED*, the FAA/FCC and other parties, including the NCTA, are engaged in a research project that may lead to a re-examination of the cable leakage rules.

Phase one attempts to detemine the true relationship between ground measurements and actual interference levels at aircraft altitudes. The project is moving ahead rapidly, assuming final FAA clearance.

ARTEC, a new cable system being constructed in Arlington, Virginia, will be selected as the needed "tight" system or best-case system. Fly-overs were scheduled for New Jersey in late June to find a suitable "dirty" system or worse-case system. This worse-case system should be on flat terrain, consist of 30 or 60 miles of plant, permit easy access to ground measurement, be isolated from other systems and leaking.

OT Laboratories in Boulder, Colorado, developed a "calibrated leak" device that simulates a known cable leak to better understand the cumulative airborne effects of many small ground level leaks. This new device may be the key to the total research effort.

Mutual Broadcasting System Files Answers to Satellite Questions

WASHINGTON, D.C.—The Mutual Broadcasting System has filed answers with the FCC to questions raised about its proposed satellite distribution system, principally the installation of 500 earth stations at Mutual affiliates in the United States, including Alaska, Hawaii, Puerto Rico and the Virgin Islands.

Questions raised by American Telephone & Telegraph, the NAB, the Oklahoma News Network and the Texas State Network ranged from interference on the 3.7-4.2 GHz frequency band to a stifling of competition.

In a 42-page brief filed by its Washington attorneys, Cohn and Marks, Mutual carefully reviews objections raised by the others, refuting them one by one and citing previous rulings of the FCC in related actions.

Regarding the 3.7-4.2 GHz band, which NBC had asked the commission to address as a policy matter, Mutual points out that the issues raised by NBC are virtually identical to those raised by ABC in a rule making procedure. In that case, "the Commission concluded that policy considerations proposed by ABC would not be in the public interest since they would impose unnecessary *a priori* restrictions on the design and operation of domestic satellite facilities, thereby limiting the flexibility of potential users for existing and new types of service."

Concluding its reply, Mutual points out it has fully responded to all comments as well as to TSN's petition to deny and requests "that the Commission give expeditious consideration to the MBS application and approve construction and operation of the requested receive-only earth station facilities."

House Sessions To be Televised

WASHINGTON, D.C.—The U.S. House of Representatives voted 235 to 150 on June 14 to have its employees control the television cameras when its sessions are televised.

The news media are not expected to have access to the gavel-to-gavel proceedings until early next year.

Reducing System Failures Due to Transients and Surges

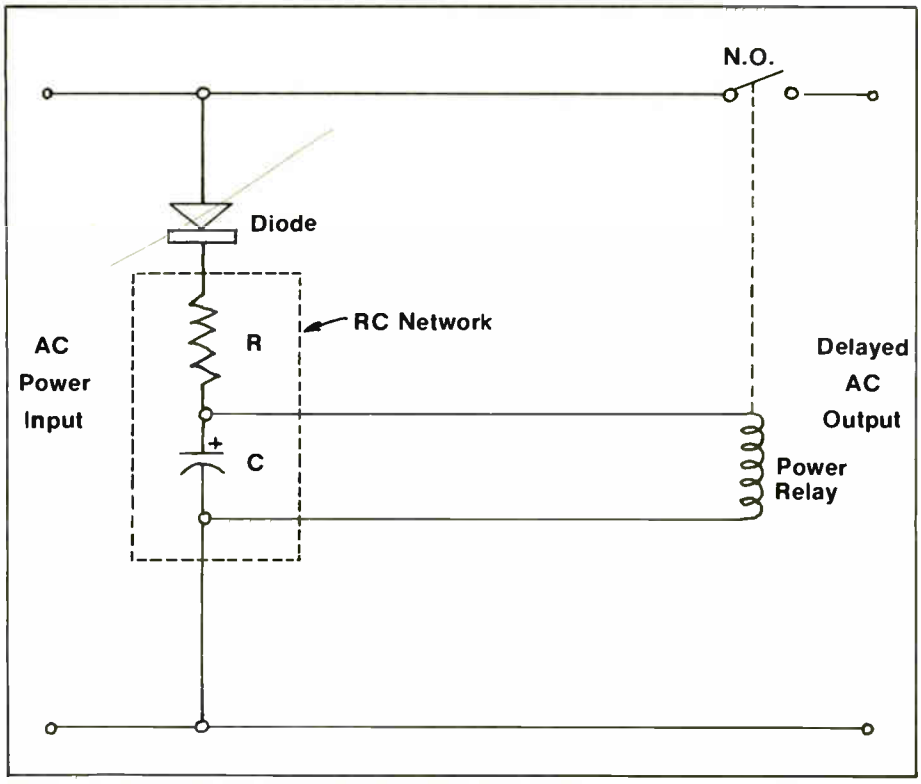

Figure 1. Simplified schematic of an RC time delay

By Earl Crandall, chairman
Robert Crandall, president
CEI Corporation
Londonderry, New Hampshire

Lightning and other line transients cause thousands of dollars in damages to CATV systems each year. Recently, improvements in some equipment have been made to allow for operation in the severe electrical environment that cable TV finds itself. The purpose of this article is to discuss some of these methods currently used to provide protection. In addition, we will specifically discuss a device that can be used to eliminate nearly all transient problems in your system.

First, let us review devices currently in use and their merit. Perhaps the most commonly used device is a gas-filled surge-arrestor, manufactured both here and abroad. For example, Semens manufactures a line of gas discharge tubes which are used by many CATV original equipment manufacturers. It is our opinion that compared to similar devices, this device does the best job of protecting components. The advantage

of this type of device is that it can be based across the RF line due to its low capacitance, (typically a few pico-farads). These devices will prevent transients from entering the equipment from trunk and distribution lines. These devices become very conductive at a specific voltage (usually 90 - 140 volts) and at that point short out the transient due to the ionization in the tube. Some line equipment is available without these protective devices, but we do not recommend their usage.

Another method of transient suppression currently being used by several manufacturers is to connect a protective device across the DC power supply, thereby protecting the low voltage components used in the amplifiers. Although there are several components that could be used in the application, we will only discuss the two most proper ones. They are the GEMOV and the zener diode. Zener diodes are used by several companies because they protect against power supply surges as well as transients. The problem with zener diodes is that they quite often short out, causing a system outage. GEMOV (General Electric Metal Oxide Varistor) devices are designed to handle surges and transients and work very well for that application, but due to their very high capacitance, they cannot be used across RF lines. Although there are several brands of varistors available, the most reliable, in our opinion, are those manufactured by General Electric.

Another method of protecting cable systems is through the use of delay timers. Timers function to delay power turn-on whenever AC power is lost and comes back on. This area is the one we wish to discuss the most, for it is the least understood.

Let us start by looking at the source of power fluctuations affecting cable TV equipment. In a city or town, electrical power is fed to customers on several feeder lines, each feederline having its own protective equipment. When there is a disturbance on one feeder line, all feeder lines in that area may cycle (anywhere from two cycles to several seconds) depending upon the setting used by the local power company officials. Because of the reactive nature of these lines, these moments of power outage tend to create large surges. These surges are the thing that must be prevented from reaching the CATV system power.

It does not seem to matter what the original cause for the surge is, be it lightning, power lines shortings, overloading or cycling of the power company protective devices. The results are nearly always the same in that the cycling of the power causes a voltage surge. As a step towards reducing equipment failure from the reactive surges manufacturers have developed an R-C delay timer to delay power-on by several hundred milliseconds. This certainly is a step in the right direction; however, we have found that a delay of only a few hundred milliseconds is grossly insufficient. Our research into the subject with local CATV systems people and local power officials has led us to the conclusion that while a delay of 20 seconds is appropriate for rural New England, other delay times may be acceptable in your area. Delay circuits are generally constructed of a relay and resistance-capacitance network. (See Figure 1). It is impossible for this kind of timer to achieve the delay times required using R-C networks directly. We, after much research into this problem, have found that the Jerrold R-C devices (Jerrold part no. PDT-30/60) could be modified to include a solid state timer in the same housing with only a few parts changes. After modifying a number of these Jerrold timers, and placing them in the field, outages due to equipment failure during storms dropped to approximately ten percent of their former value.

Figure 2 is a simplified diagram to show the operation of the modified timer circuit now in use. After the initial field trials it was found that system technical personnel were able to modify Jerrold timers with parts from a modification kit available from our company. Several systems have had such good luck using the modified timers that they installed modified timers in all power supplies and are modifying those timers already in use. The impact of this modification is both positive and negative in that it reduces the number of power failures that customers experience, but increases all outages to a duration of 20 seconds. Thus far, customer acceptance has been good due to increased system reliability. Another benefit that is due to system reliability being increased, is that of cost reduction of system spares. Also, system service personnel may be redirected toward improving picture quality rather than system repair. This may also allow system managers to reduce the personnel for servicing.

In summary, we recommend that for maximum system reliability, the following changes be implemented: 1) using line equipment with protective devices installed or adding those protective devices; 2) using delay timers in systems at each power supply location. The implementing of these ideas should increase your system's reliability and profitability as well as have a positive effect on picture quality in time. **C-ED**

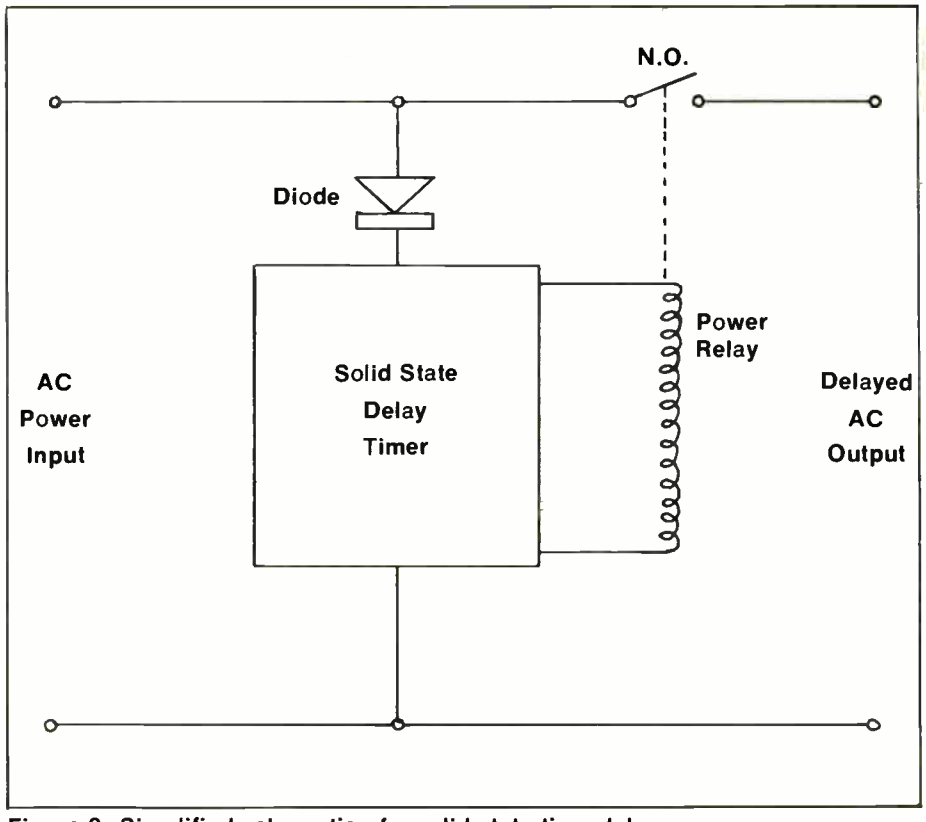

Figure 2. Simplified schematic of a solid state time delay

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Surge Protection Devices on Active Stations

By Bert L. Henscheid, director of engineering
Theta-Com CATV, Phoenix, Arizona

Electronic CATV equipment failures can generally be attributed to four modes: infant mortality, handling, environmental and lifetime limitations. Infant mortality is usually absorbed by the manufacturer during burn-in operations and warranty periods. Handling problems, such as breakage, can be improved by personnel training and attitude. By far the greatest contributor to failure is overvoltage transients due to lightning and power line faults, with the latter being the most prevalent.

As equipment manufacturers, we view protection procedures in two areas—external and internal to our equipment. External methods consist of grounding, bonding, power company interaction and general construction practices. External protection usually involves recommendations to our customers and dictates to our

subcontractors in an attempt to keep overvoltages from reaching the critical amplifier stations. Internal protection involves the design of components and circuits inside the hardware in order to prevent damage once the surge has arrived. External protection is an offensive move whereby we attack the problem closer to the source. Internal protection is a defensive move whereby we attempt to defend the fort, so to speak.

Protection devices seem to fall into two categories based on surges above or below 150 volts. The first line of protection for many years has been the SVP, gas surge voltage protector. These devices have been sworn by and sworn at. They are still the only device available which can be installed directly across the RF line. It will probably never be known just how much protection is provided by these devices but few people have the courage to remove them completely. However, judging from the replacement rate and the knowledge of how much abuse these devices will take, it is very obvious that they exist in an environment of very high energy surges. Most SVP's in use are rated at 145 volts firing level. This is the lowest "standard" value that is reliable for use on 60V AC systems. Some older 30V AC systems used 90 volt SVP and many AC power supplies use 230 volt units. The firing time is measured in microseconds and depends on the rise rate of the pulse. Any voltage greater than the rated firing voltage is clipped and absorbed by the SVP.

Overvoltage Protection Devices

The so-called crowbar circuit is a device that recognizes an overvoltage and switches to a short circuit mode, usually by turning on an SCR, silicon controlled rectifier, or similar device. The short circuit is usually intended to blow a fuse if the overvoltage lasts longer than one-third of a second. When placed on the secondary side of the transformer and before the rectifier circuit in a power supply, the crowbar can stop a short duration overvoltage without disrupting normal regulator and amplifier operation. They are self resetting, but because of their inherent high capacitance, they cannot be placed across the RF path. They can be installed in the AC circuit or in the DC circuit although networks for the two types may vary.

Zener type clippers limit overvoltages to some specified level and all energy over that level must be absorbed by the device. Smaller devices tend to fail in the shorted mode and replacement is not always easy. Large units can handle large energy levels safely. Like the crowbar, these units have high capacitance and can only be placed in the AC or DC networks.

One of the most successful overvoltage protection methods is an AC absorbing network developed by Theta-Com called the Guardian Compensator (formerly Surge Limiter). This is a network which is placed in series with the station AC transformer primary. The absorbing network is normally turned on hard, i.e. saturated, and the full AC input voltage is applied to the transformer. When the AC input voltage rises above 70 volts due to surges or sheath currents, the network starts to absorb the excess energy over 70 volts. The sensing is done by monitoring the rectified DC voltage. The action is similar to an AGC network and the transformer primary never has more than 70 volts across it. This 17 percent allowed overvoltage is safely handled by the power supply regulator. Overvoltages from 70 volts to 150 volts are effectively controlled with this network. It is also completely self resetting.

Fuses are usually thought of as protection against short circuits. Have you ever wondered why a fuse will blow for no apparent reason on a clear day? The reason is that fuses age and weaken. Most fuses in use in CATV equipment are not overly rated. Generally, a fuse value is selected to be large enough not to fail during normal operation and small enough to provide adequate protection. Two to three times operating current seems to be common. When repeated overvoltage surges occur, the fuse element is gradually weakened until one day a strong surge is enough to finally blow it. Naturally, as is its intent, crowbar circuits will react to power line surges and blow the fuse. Two types of fuses are in common use. The regular or fast blow fuse is designed for fast, immediate protection against excessive current. The slow-blow type is designed to withstand high initial rush currents found at turn-on and to provide adequate protection for normal operation.

In general, a blown fuse should be regarded as a success instead of a failure. Even though it means an outage, the blown fuse probably saved you an expensive and time consuming repair bill.

A thermal breaker, as the name implies, is a bi-metal contact switch that opens when heated. Heating occurs when the current through the device exceeds its rated value. Once the contact is opened, current ceases to flow and the heat generation is halted. When the temperature drops, the bi-metal strip returns to its normal position and closes the contact. If the high current condition still exists, the cycle will repeat until the short circuit is found and removed. Breakers in use by CATV equipment are housed in small glass tubes slightly larger than fuses. The glass tubes are sealed and provide two leads, usually at one end. Thermal breakers are rated by the current required to open them at 80° C. Because they are thermal devices, the current required to open them at -20° C is much higher than the rating value.

The following is a brief summary of the characteristics of each type of protection:

Spark Gap Surge Suppressor

- Used extensively directly on RF line to protect transistors. They are the only device with sufficiently low capacitance that can be used on coax center conductors without affecting the RF signals.
- Firing time varies with transient rise time. At 500V/microsecond firing time is approximately two microseconds. At 100V/microsecond firing time is five to ten microseconds.
- Firing point is usually 200 percent of rated voltage to allow device to turn off.
- Low impedance during conduction creates transient on ferro-resonant supplies. It can create a sustained short due to continued arcing. (A 35 amp follow on current rating will prevent this.)
- Voltage across the device can rise to 400 percent of firing voltage during ionization and prior to arcing.

Specifications:

Firing Volt.	Peak Surge Current	Follow On Current	Capacitance
90 ± 20%	5 KA	20A	2 pF
145 ± 20%	5 KA	35A	1 pF

Silicon controlled rectifiers:

- Breakdown to low impedance.
- Are hard to turn off.

Metallic Oxide Varistors (type of selenium protector):

- Fire at 200 percent of rated voltage.
- Will not take surges of ferro-resonant supplies.

Transient Clipper:

- Is a bipolar (back to back) power type avalanche or zener diode.
- Clamps at a fixed voltage level at 130 percent rated voltage.
- Does not break down to low impedance.
- Fast firing and fast recovery.
- Used across secondary of system power supply.
- Responds to peak voltage.

Fuses:

- Protect circuit devices such as rectifiers, transformers, etc. but not transistors.
- Slow acting. Slow blow fuses are used to prevent nuisance tripping.
- Firing time is in the order of one to five milliseconds to one-half second.

Thermal Breakers:

- Used in bridger legs in series with fuses to prevent nuisance fuse outages due to momentary shorts during tap installation.
- Has been used in place of fuses. Has a slighly slower firing time. Series fuse should be used.
- Cycling on permanent short can affect other bridger legs.

Crowbar Circuit:

- Used in the amplifier power supply to sense overvoltage which may be caused by transients. Zener fires an SCR which clamps voltage to low level and blows fuse.

Thyrite Pellet Arrestor:

- Used across primary of power supply to reduce transient load on primary.
- Basically a high current device.

Figure 1 shows a relative comparison of suppressor clamp levels for various protection devices. The curve for SVP will vary widely depending on the rise-time of the wavefront.

The system package can now be described by tracing an overvoltage pulse into a mainline station. The first protector encountered is the gas surge voltage protector. The pulse is clipped to 145 volts or slightly higher on very fast pulses. Voltages below 145 volts are then applied to the RF stages and the AC transformer. The coupling capacitors and ferrite matching transformers greatly attenuate any surges in the RF path. The Guardian Compensator reacts to absorb the voltages over 70 volts at the power supply transformer. With 70 volts applied to the transformer primary, the secondary voltage is usually under 35 volts. Modern high voltage rated transistor in the regulator can safely operate well in excess of this "high" voltage surge. Should the regulator fail for any reason and cause a high voltage on the B+ line, a DC crowbar circuit will activate and blow the DC fuse.

Line extender protection usually consists of gas surge voltage protectors, AC crowbar circuits and high voltage regulator transistors. Feeder lines are protected by either fuses or thermal breakers or both.

The types of protection devices needed will vary with location due to local weather, lightning, power utility quality, soil resistivity and humidity. Some fortunate systems have had very little problems with outages, while other systems with identical equipment are continually plagued. Every effort must be made to identify the source and location of the problem. Careful record keeping of station location and failure mode is invaluable in this effort. This information helps both the operator and the manufacturer to design truly reliable cable systems. **C-ED**

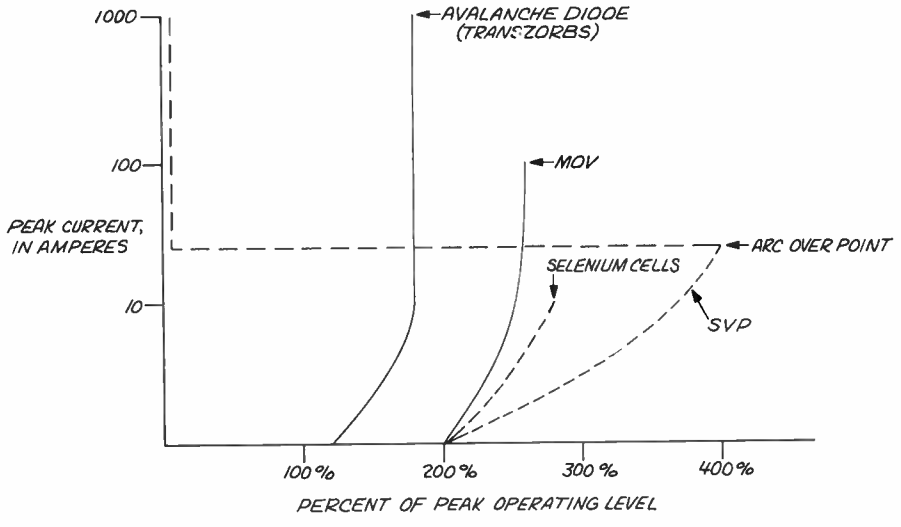


Figure 1. Suppressor Clamp Levels

References: O'Hara, Robert N., "Transient Considerations for CATV Systems" Technical Papers, NCTA National Convention, 1975.

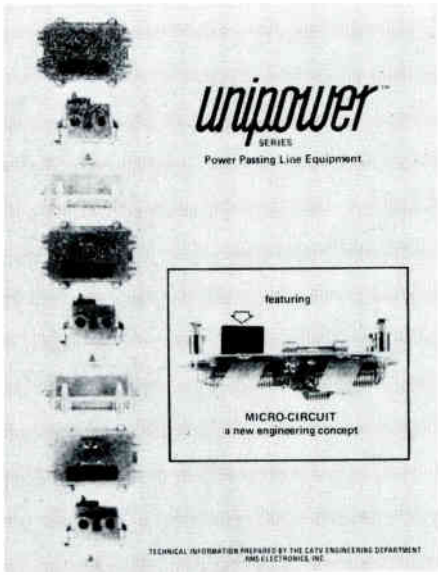
RMS Connector Catalog

RMS Electronics, Inc., has announced the availability of the most comprehensive CATV connector catalog ever assembled for CATV.

The catalog features the new "SUPERFIT"™ series with 169 pages and 350 different types of aluminum sheath, RG-59/U, RG-6/U, RG-11/U, UHF, GU, N and BNC connectors. Included are the newly designed 180 degree pedestal splices, 90 degree right angle adaptors, splice blocks, extended adaptors, AC-DC power blocking adaptors and the surge protector/test point adaptor.

Other popular items are the locking terminator, pedestal enclosure locks, stapling equipment, crimping tools and the complete line of Cablematic cable preparation tools and accessories.

For additional information, call collect: 212-892-1000.



RMS New Connector Catalog

Brochure Explains Versatile Sylvania Electronic Work Station

A three-page brochure describing the Sylvania Electronic Work Station has been published by the Distributor and Special Markets Division of GTE Sylvania Incorporated, a subsidiary of General Telephone and Electronics Corporation.

The brochure explains the advantages of the free-standing, self-contained Electronic Work Station which can be used by up to three technicians at one time. It requires only electrical and antenna connections for immediate operation.

Features discussed include: the unit's rotating microfiche viewing screen; built-in bin stock drawers; isolated and non-isolated outlets for lights, test equipment, and chassis power, and optional equipment such as roll-about carts and test jigs. Copies of the brochure are available from authorized Sylvania distributors.

New Catalog Of Ferrite Toroids And Design Considerations

Highlighted in this 24-page catalog from Ferronics Incorporated, is a section containing design and application guidelines for the Ferrite user. Included are formulas, material properties, and coating information pertaining to RF, wide band, and pulse transformers. Standard sizes, materials, magnetic and electrical properties, performance and parameter curves, and design kits are covered.

Free catalog available upon request. For further information contact: Mark B. Northrup, Sales Manager/Ferrite Division, Phone: (716) 377-6820.

New Catalog Of Ferrite Toroids

New Catalog Showcases Telonic/Berkeley Attenuator Line

A new 16-page catalog from Telonic/Berkeley showcases the firm's extensive line of attenuators. The line contains complete series of rotary step, fixed value coaxial, programmable and custom units.

The new catalog itemizes the attenuators in six different series: subminiature and minature rotary step; tandem mounted rotary step; bench type rotary step; fixed value coaxial; programmable; and special and custom designed attenuators.

A special feature of the catalog is an Attenuator Selection Guide which clearly displays the types, impedance ratings, dB ranges, dB steps and frequency ranges of the six attenuator series.

For a copy of the new Attenuator Catalog, or for more information on Telonic/Berkeley attenuators, contact the Marketing Department, Telonic/Berkeley, 2700 DuPont Dr., Irvine, California 92715.

Klein Tools Offers Booklet on the Proper Use and Care of Hand Tools

Klein Tools, Inc., is offering a new booklet which covers the proper use and care of hand tools including pliers, screwdrivers, wrenches,striking and struck tools, vises, clamps, snips, tool boxes, chest ands cabinets.

The 88 page, two-color booklet, contains hundreds of illustrations which show how to select the proper tool for various jobs: the care and maintenance of tools, and many of the hazards which can result from misuse of tools.

The booklet is available through Klein's nationwide network of electrical and industrial distributors.

New 88-page booklet from Klein Tools, Inc.

Power Supplies

New System from KeyTek Provides Unique Surge Test Capability

A new, fully-integrated surge test system that offers a tailor-made solution to virtually all existing and planned surge requirements has been introduced by KeyTek Instrument Corporation.

Including more than 30 individual components, the System 1000 makes available a wide variety of high-energy AC and DC pulses. These pulses are accurately configured to match precisely-defined waveforms which meet the surge simulation requirements of private, national and international standardizing bodies, such as the UL, FCC, IEEE, IEC and many others. The system produces pulses of up to 6 kV, 5 kA, 7.5 MW and over 1,200 joules, while instantly providing digital indications of delivered peak voltage and current.

For more data, contact KeyTek Instrument Corporation, 220 Grove St., Waltham, Massachusetts 02154, (617) 899-6200.

Power-Sonic Announces Addition of Two New Models to Line of Rechargeable Gel-Type Batteries

Power-Sonic Corporation has announced the addition of two new models to its line of sealed, rechargeable gel-type batteries: model PS-630, a 6 volt 3.0 ampere-hour battery, and model PS-1260, a 12 volt - 6.0 ampere-hour battery. Both units are usable either as standby power for burglar and fire alarm systems, emergency lighting, data terminals, and communications systems, or as a principal energy source for portable power applications.

These batteries have been specially constructed to provide considerably higher energy densities than existing models. The new PS-630 delivers 15 percent more capacity than the PS-626 of the same size; while the PS-1260 will hold a third more power in a case identical to that of the PS-1245. These high-capacity units provide extra protection in standby power applications and additional operating time in cyclic use.

For complete information, write or call Power-Sonic Corporation, P.O. Box 5242, 3106 Spring St., Redwood City, California 94063, (415) 364-5001.

Test Equipment

Two New Signal Analysis Meters From Mid State

Mid State Communications has designed two new signal analysis meters (SAM I and SAM II). The primary difference between the two units is in frequency tuning. The SAM I is a conventionally tuned meter and the SAM II is a digitally controlled meter with keyboard tuning and conventional tuning. Both meters contain the same basic features and capabilities.

While the meters are modern in design, many popular features from the past have been incorporated. Mid State has provided the manual gain control from the 727, and revived the percent modulation feature from the old 704 for hum modulation measurements.

For additional information, contact Mid State Communications Inc., 174 S. First Ave., Beech Grove, Indiana 46107, (317) 787-9426.

Miscellaneous

CableGames™: Video Games for CATV

CableGames™ are talking color video games which cable television subscribers play using their telephones and watching a dedicated cable television channel. This new service is available from Computer Cablevision, Inc. located in Washington, D.C.

Any cable television system can implement this service. A two-way cable system is not required and no cable system plant construction or modifications are needed. Also, no investment is needed in special subscriber terminals.

The CV Computer™ generates CableGames. It includes a voice synthesizer, video graphics with 15 colors, computer circuitry, and an FCC registered interface to the telephone line. The CV Computer is rack-mountable and operates from a standard 110-volt power line.

The initial CableGames offered in the service are Biorhythm, Tic-Tac-Toe, Sound Match, Star Puzzle, Robot Capture and Math Practice.

For further information, contact Ray Daly at (202) 337-4691.

Siecor Has Custom Designed Special Products

Siecor Optical Cables, Inc. believes that its standard product line of optical cables will satisfy many customer requirements. The six cables that have from one to ten optical fibers are expected to fit most applications.

The need for an integrated solution to optimize systems performance often calls for the development of a unique cable, having characteristics unavailable in the existing standard cable line. Also, as new applications of optical communications develop, there will be modifications and adaptations of the existing cables.

Further information on special cables is available from Siecor Optical Cables, Inc., 631 Miracle Mile, Horseheads, New York 14845, (607) 739-3562.

New PORTA-PATTERN™ Three-Chart System for EFP Applications

A compact, self-standing, self-protective chart carrier which can be ordered with any three PORTA-PATTERN™ 9" x 12" television camera test charts has been introduced by Telecommunications Industries Ltd. Designed for use in the field with ENG and EFP cameras, the carrier opens into a triptych which will stand alone on any reasonably flat surface. When not in use, it is held closed and the charts protected by mating "Velcro" strips affixed to three hinged, high impact acrylic plastic frames holding the charts.

Specially designed hinges interfold the three charts into a compact package less than 15" high, 18" wide and 1½" thick.

Complete catalogs and a chart-specifying order blank are available from Telecommunications Industries Ltd., 6335 Homewood Avenue/Suite 204, Los Angeles, California 90028, (213) 461-3561.

Q I had a hum problem in my system which drove me crazy. I checked power supplies, grounds and everthing I could think of. Nothing worked! While tracing a leakage problem, I discovered a loose connector and after cleaning and retightening, both leakage and hum were gone. What gives?

A You have a solution, of course, but the reasons are somewhat obscure. When a connector with an aluminum outer and copper center conductor is exposed to moisture, oxides are formed. These oxides, particularly copper oxides, act like semiconductors.

As the AC power alternates from positive and negative, the oxide junction is biased on and off. This switching action causes impedance changes to occur at the junction point. These impedance changes act to modulate the RF signals present at a 60 Hz rate. The result is a "hum line" in the picture.

Since the outer conductor (shield) is also imperfectly conducting, it is a natural point for radiation to occur.

Q What is the reason for using surge arrestor in equipment?

A There are several reasons for using surge arrestors:

1. Synthesized Surge Tests. This is done on equipment with a production type surge generator at all ports three times without any performance degradation.
2. The impedance to ground at low frequencies at each port. It has been found that most of the energy of a surge is concentrated at low frequencies and very little is concentrated at the higher frequencies. Therefore, return amplifiers operating at low frequencies should be protected and forward amplifiers operating at high frequencies are not expected to be as vulnerable and may not require the same protection.
3. The effect of a shorted surge arrestor on AC powering. This may sound strange, but surge arrestors operate on an impulse voltage, and repeated impulses can cause an arrestor to short out. The arrestor that protected the equipment now presents a short to the AC powering system. An AC current will flow limited only by the impedance of the AC system (roughly the spacing between the shorted arrestor and the AC power supply).

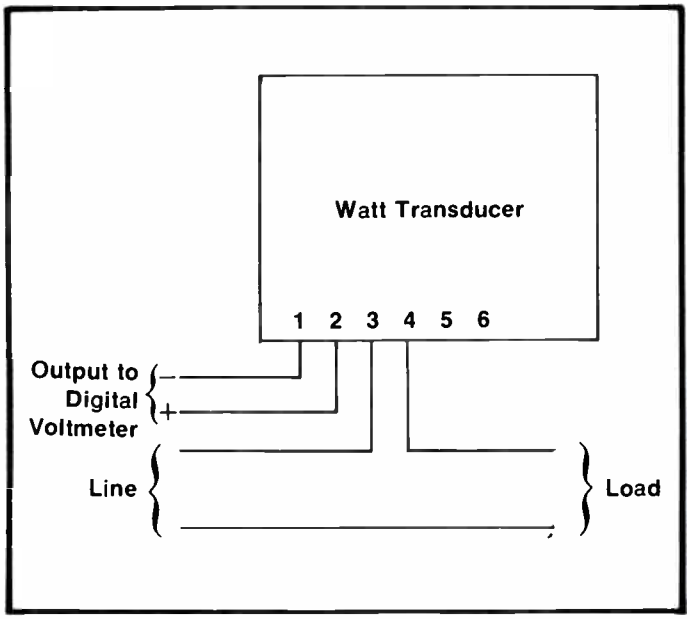
   The surge arrestor has to be able to pass this follow-on current from the AC power and return to normal after the impulses have stopped.

Q How do you measure true RMS power consumption of CATV equipment with minimum equipment investment?

A A true-reading RMS meter or an iron-vane movement type is required for square-wave powered CATV equipment. Digital indicating instruments are available started at $985-up. A simple approach is to use a Watt transducer and any digital voltmeter (or analog) you may have around the shop.

Watt transducers start at $167 each and can be made for any range or multi-range required. They are Hall Effect multiplier devices that provide DC output voltage proportional to the electrical power consumed regardless of the waveform in single and three-phase loads of equipment (i.e. 10 to 50 watts input produces 0 to 10V DC output). Accuracies are on the order of 0.1 percent.

The manufacturers connections for one phase, 2-wire hook-up is shown:



"Out of Sync" is a forum for and by technicians and engineers. If you have problems, simple or sophisticated, you're not the only one. Please submit your questions and/or solutions to *C-ED*, in care of Toni Barnett. We'll do our best to provide as much assistance as possible.

Senior Citizens Go Public

By Peter Warner. West Coast Correspondent

The Public Access Cable Television by and for Elders project in San Diego County, called PACE, is jointly supported by four public institutions: the University of California at San Diego School of Communications, the UCSD adult education extension program, the very active Community Video Center and the Center on Aging at San Diego State College.

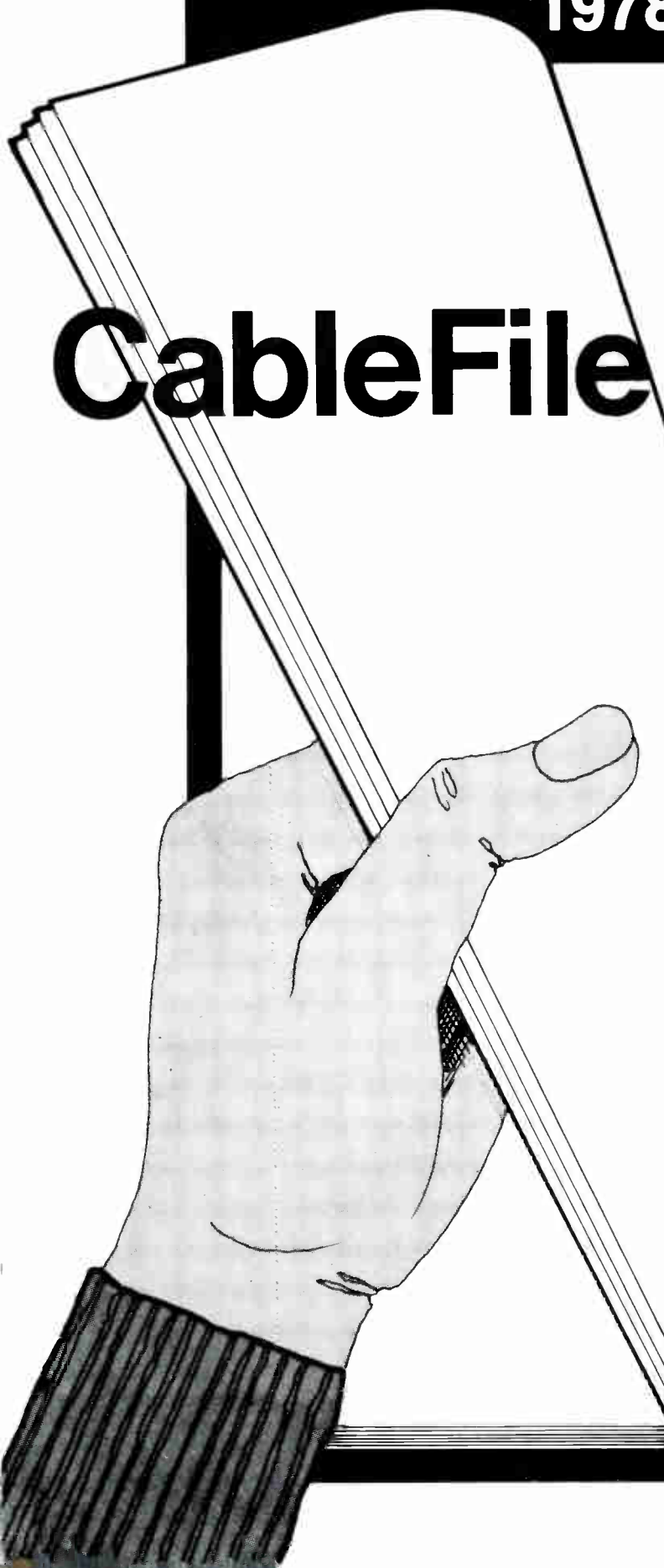
UCSD assistant professor Mike Real, chief administrator of PACE, has helped line up the production facilities for PACE and reports that, "Our goal is to have a series of production centers scattered geographically around the county, so that people from those areas can come in and make programming, which can then be transmitted throughout heavily cabled San Diego County." Three televison studio facilities and half-inch Sony "portopack" gear are used by senior citizens, sometimes with student or professional help, to produce 40 hours of diverse public access programming per week, which is now transmitted to about 70,000 Mission Cable homes and about 18,000 Southwestern Cable homes. Beginning on July 2nd, about 240,000 cable subscribers of half a dozen San Diego County systems including Mission and Southwestern were able to receive one-half hour of high-caliber PACE programming per week on their local orgination channel.

The PACE utilization of local university and public resources should be an inspiration to other cable operators with limited manpower and facilities of their own. Says Mike Real, "Our technical set-up is very much a patchwork quilt—begged and borrowed." PACE started out using a UCSD black and white television studio, and then graduated up to a multi-camera color studio in September 1977, that would make any cable operator jealous. The facilities include two Sony DXC-1000 one vidicon color cameras; a four-bus video switcher with special effects wipes, dissolves, mattes, and chromakey; a complete audio board; and vectorscopes, waveform monitors, a time base corrector and character generator in the master control room. There is even an Eigen magnetic disc recorder for slow or fast motion inserts. The 24-foot by 55-foot studio area includes a high ceiling and a sophisticated lighting grid complete with dimmer circuitry. Electronic repair facilities and a scenery shop are nearby.

The two other studios currently accessable to PACE are much simpler than this sophisticated UCSD color studio. The Downtown Senior Center, a large and active service and recreational facility, has a small 20-foot by 20-foot black and white studio. The Chula Vista Public Library also has a simple black and white capability, which it hopes to upgrade to color.

The 40 hours per week of public access programming and the half-hour per week of local origination programming which PACE delivers to the most heavily cabled county in the nation are indeed impressive. In keeping with the project goals of enhancing communication by and for elders, content takes precedence over slick production values. It wouldn't have been possible without the cooperation of public institutions in San Diego County, and without the availability of low cost, reliable industrial-quality videotape equipment.

More information on cable than ever before with the 1978 CableFile



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Canadian Satellite Usage Attempting to Get Down to Earth

By Kenneth Hancock, director of engineering, CCTA

There have been Canadian domestic satellites orbiting now for six years. Transponder space on the satellites has been vastly under-utilized throughout the years. For the most part, Telesat Canada, the organization that controls use of Canada's satellites and earth stations, has lost money. At the same time the Canadian cable television industry has been expanding and urgently seeking viable long-haul transmission facilities.

These two statements put together do not seem to make a lot of sense, but they do represent the current situation in Canada. There are many reasons for the lack of utilization of Anik satellites, but at the heart of the problem is Telesat Canada's marketing strategy. At present, the organization offers only complete transponder channels, and these for a minimum of five years.

Telesat requires that ground station ownership remains in its own domain, and that the leasing charge for the transponder includes the leasing of ground stations. The combined rental has in the past been quoted on the order of $3 million per year. With bank guarantees for five-year usage required, the $15 million has generally been beyond the means of cable television companies. There have been a number of attempts over the past six years to break this deadlock. One of these was the formation of a company called Cablesat by two of the largest Canadian cable TV organizations. Cablesat was intended to act as a broker of transponder time, making smaller portions available for the industry as a whole. For a number of reasons, mainly money, this project never became viable. Telesat itself attempted to produce a package based on a "per subscriber cost" for the cable industry, but again due to money, and partly due to lack of experience in the cable industrys needs, this project never came to fruition. Finally, the TransCanada Telephone System (TCTS) proposed a very ambitious project to use a large number of transponders for many purposes including serving the cable television industry as a whole. This was termed the "Gate-Way Project." This project did not suit the needs of the cable industry or any of the other industries to which it was proposed.

With the need for Telesat, which is now part of TCTS, to lease transponder space becoming more and more urgent and with the needs of the cable industry still unfulfilled, there has been over the last few months, a major upsurge of activity in the satellite field.

A cable company from the maritime provinces of Canada has recently filed an application with the CRTC for a satellite network to feed the atlantic provinces of Canada. It's too early to make an assessment of this particular application, but combined with the other activities it adds to the urgency of the situation from the viewpoint of the cable industry, Telesat/TCTS and the regulatory authorities. The need for satellite distribution and the activities taking place to fulfill these needs have never been greater. Let's hope that this time these activities meet with success.

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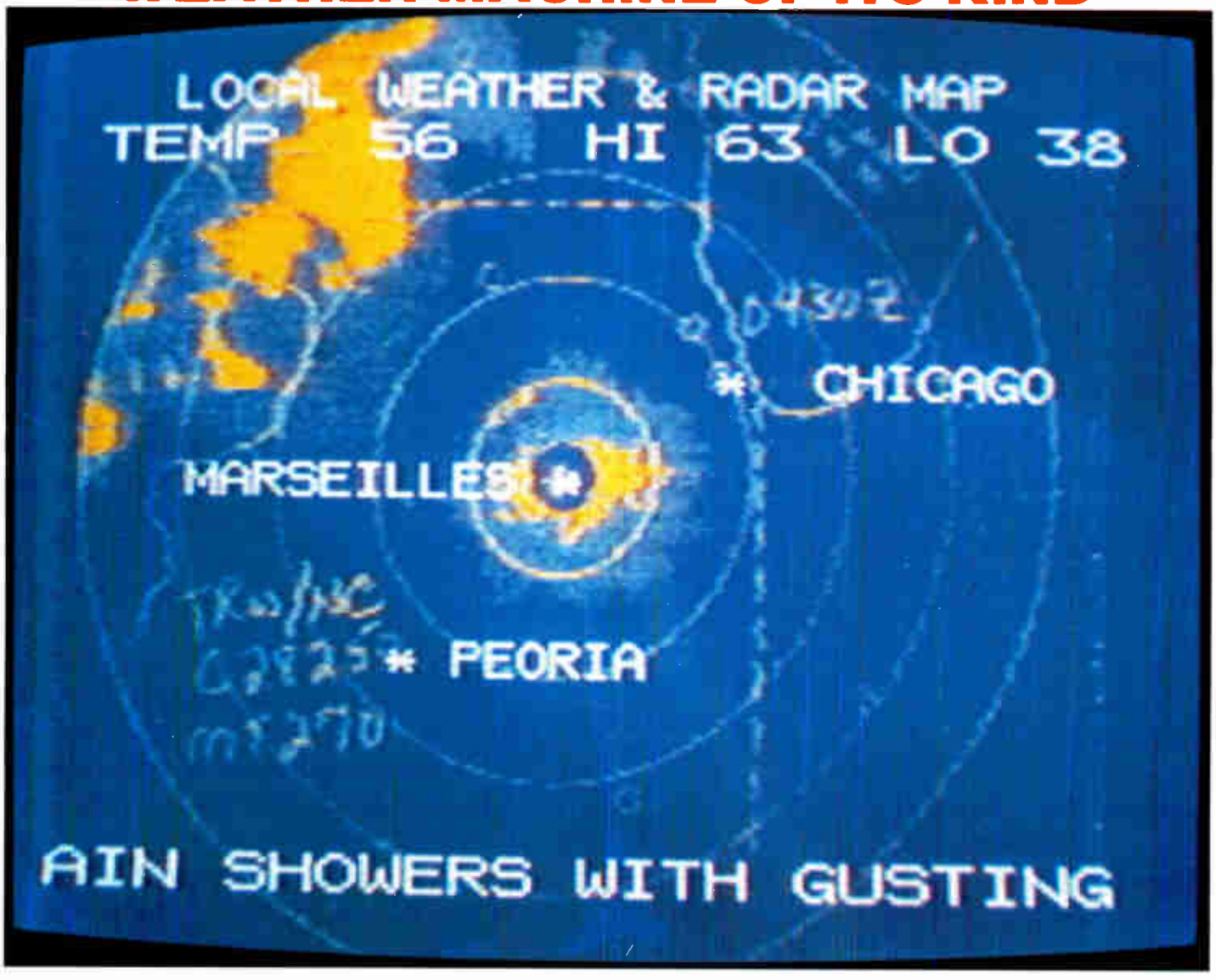

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215-461-0353

ComSE Sales Corp.
Lawrenceville, GA 30245
404-963-7870

Help Wanted

CATV ENGINEERS TELEPROMPTER CABLE

Has positions open from district engineer to line technician in various locations throughout the country. Send resume to:

Teleprompter Corporation
888 7th Avenue
New York, NY 10019
Attn: Director of Engineering

We Are An Equal Opportunity Employer
Male/Female

SYSTEM TECHNICIANS

Expanding, privately owned MSO is seeking experienced, self motivating personnel. New systems: 40 and 55 mile plants. Supervise all electronics during construction and operation. Headend experience and system turn-on required. Excellent wages and growth opportunities in sunny southwest.

Send resume and salary history to Box C- ED-0703-1.

FIELD ENGINEERS

Major equipment manufacturer and turnkey supplier has immediate openings for qualified personnel as well as trainees. Must be free to travel and relocate as required. Salary commensurate with experience. Liberal company benefit program. Contact:

RCA Cablevision Systems
7355 Fulton Avenue
North Hollywood, CA 91605
Attn: Bill Brantley
Manager, Field Engineering

CONSTRUCTION PERSONNEL

Due to the expansion of our company, we need several experienced full charge job supervisors. We are also interviewing subcontract construction crews and splicers. Immediate employment for those who qualify. Call or write:

David McBee
Commco Construction
5555 N. Lamar
Suite L103
Austin, TX 78751

New Phone Number: (512) 454-5696

CHIEF TECHNICIAN

Full responsibility for maintenance and technical operation of a 160-mile, 8-year-old system with 9,000 subscribers. Successful candidate will have strong cable electronics background and significant supervisory experience. Second class FCC license preferred. Salary commensurate with ability and experience. Excellent company benefits package. Send resume to:

William Hinton
Continental Cablevision of
New Hampshire
474 Central Avenue
Dover, NH 03820

CATV TECHNICIANS

Rapidly growing 400-mile Florida system is seeking experienced system technicians. Must have minimum of one year trouble-shooting and maintenance background. Located on southwest Florida's Gulf Coast. Many company benefits, including profit sharing plan. Send resume with salary history and requirements to:

Southern Cablevision
P.O. Box 1360
Ft. Myers, FL 33902
(813) 334-8055
Attn: Chief Engineer

LARGE FLORIDA CABLE SYSTEM

Seeking experienced technicians for growing operation. Duties include troubleshooting, repair, field maintenance, use of spectrum analyzer, 727 field strength meter, system sweep equipment and other related equipment. Excellent salary and benefits package. EOE

Reply to Box C-ED-0703-2

INSTALLATION SUPERVISOR

Large midwestern converter system needs experienced installation foreman to supervise installers and subcontractors.

Only candidates with proven personal skills and desire to lead by example need apply. Compensation commensurate with experience and ability.

Send resume and salary history to:
Director of Engineering
Continental Cablevision, Inc.
333 Washington Square North
Lansing, MI 48933

CATV TECHNICIANS

Major MSO is seeking experienced technicians for growing operations. Duties include troubleshooting, repair and field maintenance. Good salary and benefits package. Send confidential resume and salary requirements to: Box CV-1107-2.

DISTRICT ENGINEER

Major MSO looking for individual qualified in system design, construction, FCC performance testing, equipment repair and microwave maintenance. Position to oversee technical standards in 4 south-eastern systems. Salary open. Send resume to:

District Manager
P.O. Box 58005
Birmingham, AL 35209

Business Directory

Equipment Wanted

CHANNEL 11 UP CONVERTER

Input and output filters frequency group D for Theta-Com AML transmitter.

Ajo TV Service Company
733 2nd Avenue
Ajo, AZ 85321
(602) 387-6012

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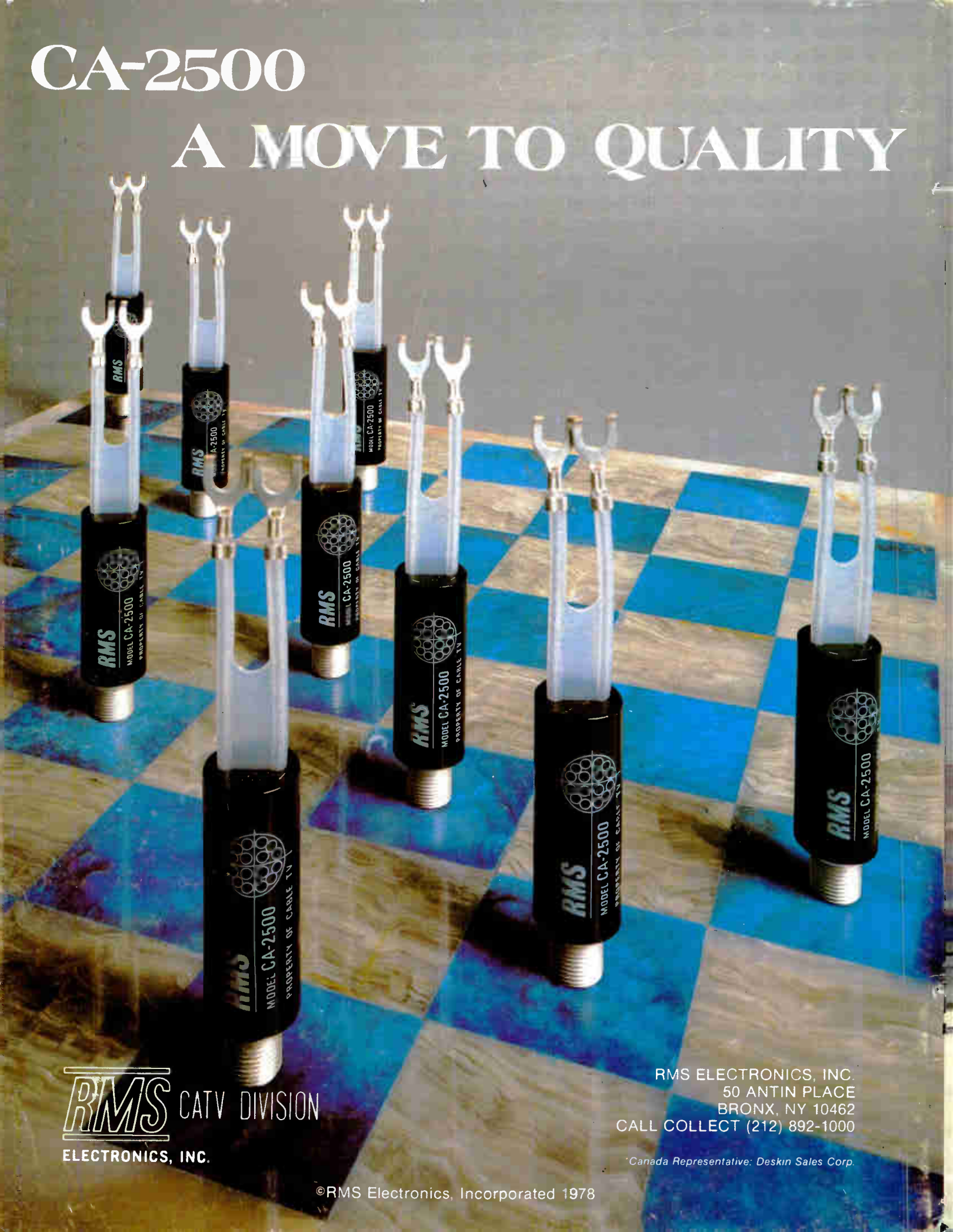

RMS CATV DIVISION
ELECTRONICS, INC.

RMS ELECTRONICS, INC.
50 ANTIN PLACE
BRONX, NY 10462
CALL COLLECT (212) 892-1000

Canada Representative: Deskin Sales Corp.