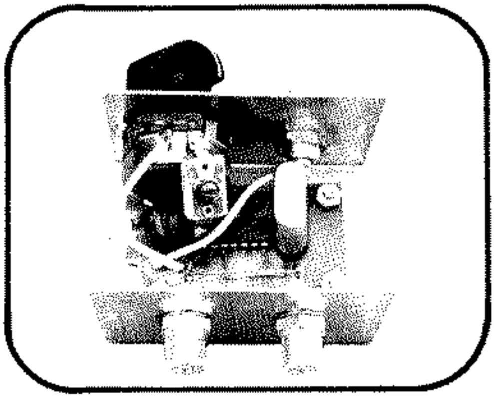
CATJ

JUNE 1975

ADD A "KISS" OF COLOR



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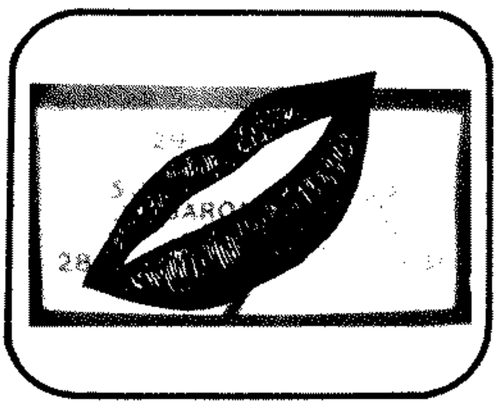

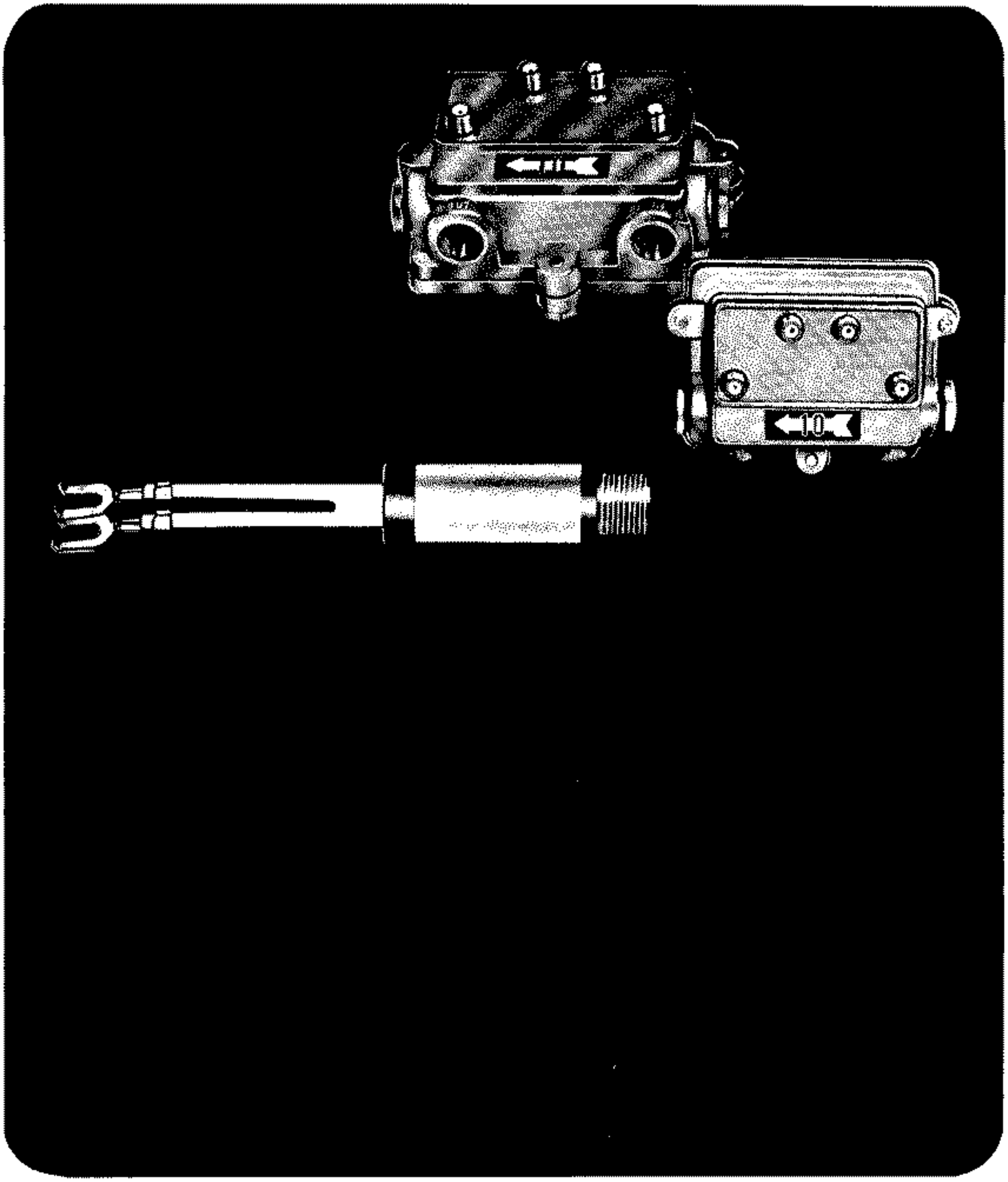


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CATJ

JUN. 1975

VOLUME 2
NUMBER 6

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—CONTENTS—

OUR COVER

No, Linda Lovelace is not loose in CATV land. But a couple of weird looking weather channels around the country now have red lips planted on their weather instruments displayed in red with a black and white camera! Find out how on Page 16. Weather channel by Robinson Engineering; lips by Debbie.

CATA -TORIAL

KYLE D. MOORE, President of CATA, INC.

WHAT'S IN A NAME?

Names. They used to be **self explanatory.** Take Standard Oil Company as an example; Standard Oil obviously was not in the home building business. But EXXON...good grief, that could be almost anything. They could grow avocados or sell pencils on the street corner.

Or take the National **Community** Television Association. Part for part it obviously **meant** a nationwide (National) locally oriented (Community) pictures and sound (Television) group of entrepreneurs (Association). NCTA started off as the national Community Television Counsel, in Pennsylvania, but changed Counsel to Association in the process of becoming a legal entity. Of course that has not been the only change in the name; in the 60's the word **Community** became a new word; **Cable.** Most who were around 10 years ago, when the change took place, recall that some proponents of change at the time wanted a more drastic change in the name; several even wanted to eliminate the word **Television.** A popular (or if not popular, at least often bantered about) proposal had the NCTA becoming the NCCA; which was to stand for National Cable **Communications** Association. That one missed by a few votes at the time; but its day may yet come.

Now let's take CATA or **Community Antenna Television Association.** Community obviously relates to the localized (or centralized) area of operations. Antenna probably needs no explanation. Television could be a part of the two-word phrase "antenna (—) television" or it could stand alone; meaning simply "sight and sound communications". Again, Association needs no additional explanation; it is a voluntary collection of people with similar business goals and activities.

At CATA I am often asked "why did CATA revive the word **community** after NCTA had dropped it many years prior"? I am further asked: Does "Community Antenna" mean that CATA represents only **independent** operators (that one leads to 'what is an independent operator?')? Does "Community Antenna" mean that CATA represents only **small** operators (which leads to 'what is small?')? Does CATA represent only systems which do not originate programming (which leads to categorizing of programs)? Does CATA represent only systems which do not originate pay movies or sports (which leads to the televising of local high school sporting events)? Or, does CATA represent only systems which **never** intend to provide broadband services (which once again leads to systems that mix in services normally associated with broadband **with** their present off-the-air signals on the **standard** 12 VHF channels)?

CATA's full name was chosen with the deliberate intention of bringing not only the word but also the concept of **"community"** back into CATV. That may need some further explanation. The NCTA, and the FCC, in an attempt to sell **their line** that CATV has great potential beyond the "mere re-transmission" of broadband television signals, has opted for the elimination of the word "Community" and its direct replacement with the word "Cable". And in this word-game, many have perhaps forgotten that the roots of CATV are in the community itself.

CATV's operation is, in virtually every case, **created at the local level.** The local terrain, the local topography, the local distribution of people and homes along creek or river beds or strung throughout valleys **creates the need.** The need, for example, for school teacher John L. Maxwell of Benton, Ohio to design and build his Wired TV System in 1953 was locally mandated. Nobody from Washington, or even Columbus conceived the need for Benton's Wired TV System. Local people in Benton did; and John Maxwell filled that need.

In virtually every case, the services CATV provides and rates charged for these services reflect **community** standards, **community** aspirations and **community** economics. In the long run, and in the day to day operations, it is the **community** in which the system operates that determines system need and system success. And it is to this **community** that the system owes both allegiance and responsibility.

CATA was founded upon these recognitions; and it believes strongly that services delivered, rates charged, and provisions of contractural agreements between system operators and the **communities** served are primarily (if not totally) matters of local concern; which must be **individually** tailored to the individual and unique requirements of **each community.** Such matters cannot be nationalized or mandated from Washington, by any realistic stretch of the imagination.

And so too it is and must be with any and all "services" offered or carried by a community system. Broadband services, pay cable movies, pay cable sports, access channels and the like may well be desirable and even necessary in many communities. Or none of these expanded services, or only some of these expanded services, may be appropriate in a neighboring community.

The **needs** of the community, **determined on an individual basis by each and every community,** must be reflected on a community by community basis. The "big brother in Washington knows best" approach always has as its objective "equalization of services through nationalization of policies, rules, regulations and even laws". However, the federal government has recently determined that they cannot tell cities and states how to spend every federal tax dollar that sifts back down to the local level; and slow progress is being made to return to the cities and states the almost lost **right of self determination.**

And while CATA recognizes that certain federal **guidelines** may be appropriate and may even be educational to the city or town groping with the regulatory position it should take with respect to its local CATV system, CATA also believes that the federal government has no business or right or justification to become involved in matters of purely local concern which Washington has demonstrated time and time again it is not equipped to handle with the same speed, or aptness as local people.

The community is the foundation of our endeavors. As no two communities are alike, so too are no two community antenna television systems alike. With each variation between Communities there too must be variation between each community's CATV system. **Nationalization** of all or most all rules and regulations concerning CATV can lead only to the ultimate failure of CATV to be **responsive** to the needs of the **singular community** which it has been designed to serve. And when our industry is regulated out of being responsive to the needs of our individual communities, in favor of being responsive only ultimately to some Washington perceived **national communications policy,** we are as an industry all washed up. And with our demise will go our community's only real hope and aspirations to utilize for the good of the community our broadly conceived potentials for community good and betterment.

If you believe that the decisions affecting your system or systems, your town or towns, what your systems offer and what they charge, are mainly of concern to you and your community, first and foremost, **then you understand why CATA is called the** Community **Antenna Television Association.**

MID-STATE COMMUNICATIONS vs. SLM/FSM CALIBRATION

Open Mouth—Insert Meter

During the months of October-January just past, *CATJ* ran a four-part series dedicated to exploring the present "state of the art" of field-strength or signal-level meters. In that series we investigated the various approaches taken by manufacturers in developing for industry use meters which accurately (or not so accurately) read out for the operator the apparent or real RF (carrier) signal levels present.

The problems associated with accurately reading signal levels in the field under often times adverse conditions are many. Most were covered in abundant detail in the four-part *CATJ* series just referenced and will not be belabored here again. Will not, that is, save *one:* the problem associated with meters which employ a peak-type detector circuit to sum the apparent total signal power present from both the carrier wave *and* the associated modulation.

As CATJ noted on Page 29 for January, "*It seems to us that one way to settle the industry squabble about whether you align an SLM/FSM on an unmodulated* (CW) *carrier or try to utilize a modulated TV signal is for manufacturers of reference signal generators to provide some simulated video modulation capability for the reference signal generator.*"

The basic question? On a typical meter, what is the difference in indicated level reading between a peak-reading detector meter that is aligned on a CW (i.e. *non*-modulated) carrier and that same meter in use in the field reading *not* CW carriers but *amplitude modulated video carriers?* Is the difference 0.5 db, 1.0 db, 1.5 db, 2.0 db?

Is the difference the same (i.e. is the ratio between CW carrier readings and modulated carrier readings *identical*) for *every* portion of the *meter scale?* To put it another way, if on a particular meter you find upon testing analysis that the meter reads with a reference carrier generator source + 10 dBmV for a CW carrier and +9 dBmV for a modulated (AM) video carrier, will that *one db difference* (lower for modulated signals) also hold true when the same meter reads a +1 dBmV signal (CW), which would (you suspect) now be 0 dBmV for a modulated carrier?

Do not jump to any conclusions about these questions. The real facts may surprise you just a tad! In fact, previous information generally circulated in *other* trade publications may have been *very much in error,* as we shall see.

Most of the CATV industry *assumes* that there is an *average* correction factor of 1.0 db for CW carrier to modulated (AM) carrier readings. That is, most people *assume* that if the meter was aligned to read +10 dBmV (real

MC-50 Specs

Frequency Range	4-300 MHz
Output Capability	+50 dBmV max —10 dBmV min
Control Range	1 db steps
Amplitude Accuracy	+/— 0.25 db
Amplitude Modulation	horizontal sync pulse, 50%
Carrier Stability	5 kHz drift max
Level Control	closed loop system, meter monitor
Output Impedance	75 ohms
Weight	10 lbs.
Dimensions	11"W, x 7"H, x 11.2"D
Power Required	115 VAC, 40 watts
Price	$695.00
Manufacturer	Mid-State Communications, Inc. Box 203, Beech Grove, Indiana 46107

level) with a +10 dBmV CW carrier, then when you take that meter and read an identical level *modulated* TV carrier, it will read +10 minus 1 db or +9 dBmV. In other words, a carrier, modulated, *these people tell you*, subtracts 1.0 db level from the signal present over a straight CW reference carrier reading.

This may not be correct.

Basically, one wonders *why* SLM/FSM meters are aligned *on CW carriers* for absolute (i.e. true-level purposes) values. How many times a day do *you* sit down and measure *CW carriers?* Most of your readings are of (visually) *modulated TV carriers*, whether they come from off-the-air TV signals or locally generated (i.e. modulator-derived) sources. And with modulation present, we have a normal situation where a carrier *plus* amplitude modulation is the norm—not the exception. Yet most (if not *all*) meters apparently exit their respective factories aligned for absolute level reading accuracy with a *straight CW* (unmodulated) carrier. Seemingly, this may be the *reverse* of real life. Why not align meters with a reference signal generator that *has video modulation* present, which means that a +10 dBmV absolute level, to the SLM, would dove-tail or coincide with the kind of +10 dBmV real-life signals you, the user, will be measuring in the field? Then if you want to add a correction factor for your system-secure CW carriers (pilot carriers for example), and your aural carriers (FM modulated), such as *adding* 1.0 db for any levels read to derive the real-life levels on your meter face, you can do so. Measuring pilot carriers and aural carriers is in the *minority* of all measurements made; so why not *limit the correction factor* to the *minority measurements*, rather than the majority (i.e. visual carrier with modulation) measurements?

These questions raced through our minds (some crawled rather than raced!) back last fall as we prepared the series on SLM/FSM instruments for *CATJ*. And as noted, we wondered in print (aloud as it were) on Page 29 about these conditions.

With our mouth open, one manufacturer of CATV instruments took us up on the "challenge," and the result is the new *Mid-State Communications, Inc.* MC-50 Meter Calibrator.

The Basic TV Video Signal

Very very basically, the relative amplitude of a normal TV signal, amplitude modulated, appears as shown in Diagram 1. The horizontal pulse/sync pulse levels are averaging higher in level than the highly varying video information (modulation) content of the signal. A white TV screen has a modulation depth (or percentage) of 87%.

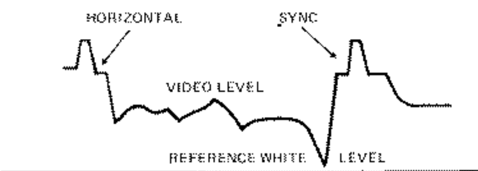


DIAGRAM 1

Because picture content on any TV scene changes almost *continuously*, you are experiencing constantly changing percentages of video modulation on any picture received (except of course color-bar patterns, ID slides and so on). Therefore transmitter engineers deal in the world of averages, noting as they will that between 40 and 50% modulation is present *on the average*.

SLM/FSM manufacturers incorporate into their instruments a peak-reading detector, which is a bit of a misnomer right off the bat. A true peak-reading detector would read only the peaks and display only the peak modulation (+ carrier) levels present, *in real time*. However, *real time* is a bit fast for you or me to track the meter-needle movement (and a bit fast for the meter-needle movement to track in *real* life), because of the aforementioned constantly changing picture content/video modulation percentage present. So the peak-reading detector (a diode typically) *does read peaks*, but directly *after* the detector that *reads peaks* is a *charging capacitor* (Diagram 2) which *holds* the peak reading from the detector for some period of time (small) until the next peak comes along (i.e. the next cycle). The *charging capacitor* in effect *averages* (maintains) the peak, taking the peak present in one cycle and *holding it* until the next cycle occurs. Thus the *real peak detector* is a *combination* of *peak reading* and *average sustaining*, through the *combination* of the detector (diode) and the charging capacitor. And the basic problem with this scheme is obtaining *sufficient detector energy* to charge the capacitor and to *hold that charge* in the capacitor without bleeding off the detected horizontal sync pulse before the next pulse is created.

The charging energy for the capacitor tied to the aft end of the detector diode is a very important source for error. Most SLM/FSM instruments have a 20 db meter scale width (*Sadelco* meters have a 30 db + meter "window"). A 20 db range is a 10 to 1 voltage change or range, *through which* the meter detector must function. A meter with 1.0 volt on the detector at full scale has 100 mV on it at minimum scale, for example. To maintain an adequate *charge-holding time period* (cycle) for the detector/charging capacitor, the meter designers try to maintain a very high impedance *load* on the detector/charging capacitor combination. In the process of all of this, the linearity of the detector/capacitor combination is *distorted* so that in *real life* the detector efficiency (i.e. the rate of *conversion* of input RF level to output DC voltage) is lower for lower input (RF input) levels to the detector. This is one of the major contributing factors which affect *accuracy* of absolute-level measurements in present-day CATV instruments. And this is a contributing factor to the meter manufacturers, urging all users to *read absolute levels* in the top 5-10 db *portion* of any meter scale range they may happen to be using; in effect, keeping readings which must be accurate in the top portion of the scale (*any scale*), where all meter design factors, *including detector efficiency*, are optimized for accurate performance.

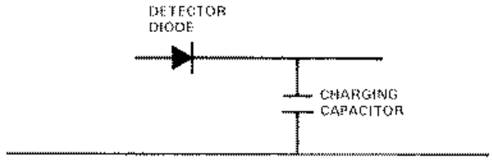


DIAGRAM 2

The Basic MC-50

The basic MC-50 meter calibrator from *Mid-State Communications, Inc.* recognizes these inherent problems with *all* instruments. What Mid-State has done to make life easier, and more accurate, for you as a signal level meter user/calibrator is to provide you

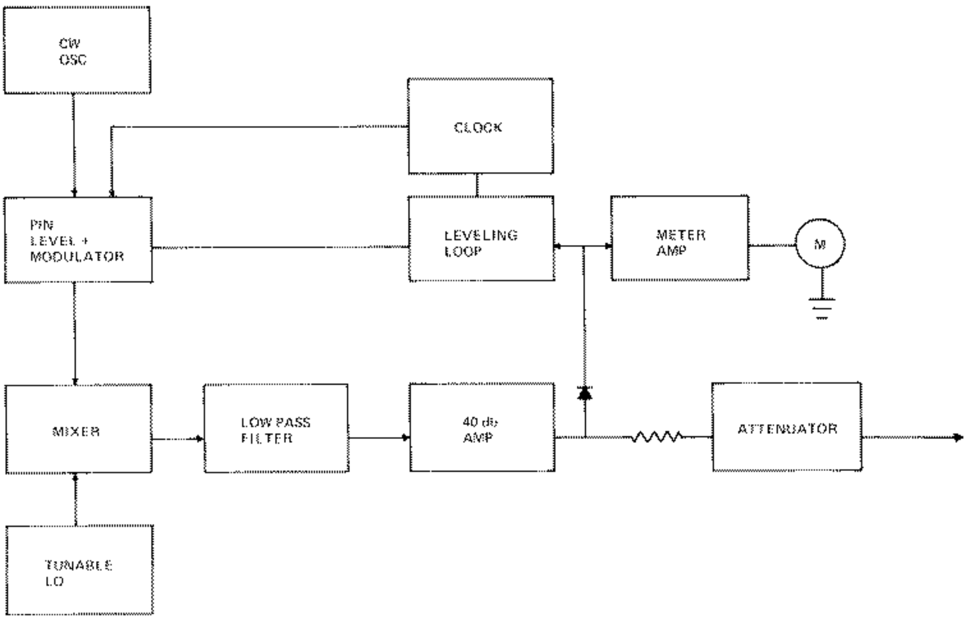


DIAGRAM 3

with a tuneable reference signal generator that has both straight CW (AØ) carrier output, and at the push of a button, 50% (simulated) modulated carrier output.

The MC-50 utilizes a high output (level) tuneable oscillator that covers the frequency range 4-300 MHz in two bands: from 4-150 MHz and from 150-300 MHz. The desired operating frequency is selected by the user, by simply selecting the proper band and rotating the large front-panel knob to the desired carrier frequency where the SLM/FSM will be aligned. The white circular dial is marked in frequencies (5 MHz increments) and in VHF channels (plus mid-band and super-band).

The tuneable local oscillator is mixed with a fixed frequency (CW) oscillator in a double balanced mixer. The fixed frequency oscillator is where the simulated 50% video modulation takes place (see Diagram 3). A leveling loop controls a pin diode leveler, and the resultant signal is monitored by a hot carrier diode and displayed on a front-panel meter. Similar in concept to the Bolometer circuit on the *Measurements* 950 signal generator (see Pages 34-37 for January *CATJ*), the meter display is a go-no-go situation. As long as the meter displays the needle in the *center* portion of the scale, the self-balancing leveler circuit is operational and the calibration of the unit at the factory is maintained in operation. Any deviation of the meter needle from the center portion of the meter display is cause for concern; in effect, the meter serves as a *warning system* that something has gone awry in the unit.

The MC-50 Meter Calibrator has a maximum output level of +50 dBmV with two front-panel step attenuators (rotary). One rotary has six positions in 10 db steps (0-50 db of attenuation), while the second has 10 positions in 1 db steps (0-10 db of attenuation).

The digital modulation circuit, duty-cycled to represent *50% average modulation* keyed to the horizontal sync pulse, is connected into the level control circuit to ensure that *no change* takes place in the peak carrier level *when modulation is switched on.*

TABLE ONE

Five meters in the **CATJ** lab at the time the MC-50 arrived were checked for the meter-indicated differences between an AØ (CW) carrier, without modulation, and a modulated carrier as provided by the MC-50. These tests were repeated at full meter scale, mid-scale (i.e. 10 db lower), and low end of scale (i.e. 20 db lower than the first level). Thus we repeated the test three times with **each** meter (six times with the B-T FSM-2 as shown) to get an indication of not only the meter-reading difference between a CW and modulated signal, but also an indication of **how meter detector efficiency changes** throughout the meter-scale range.

Meter	Full-Scale Difference *	Mid-Scale Difference	Bottom-Scale Difference
Jerrold 727	1.1 db	1.6 db	could not measure accurately
B-T FSM-2			
(1) Peak	1.3 db	1.9 db	could not measure accurately
(2) Average	2.8 db	1.9 db	could not measure accurately
Benco FST-4	3.0 db	3.0 db	3.0 db
Sadelco FS-3SB	1.0 db	2.0 db	2.2 db
Mid-State SLIM	0.1 db	1.0 db	2.0 db

* Difference was always **lower indicated levels** when modulation was added; therefore typical users would **add** differences shown above (when verified for their own instruments) to obtain true peak readings **with** video modulation present.

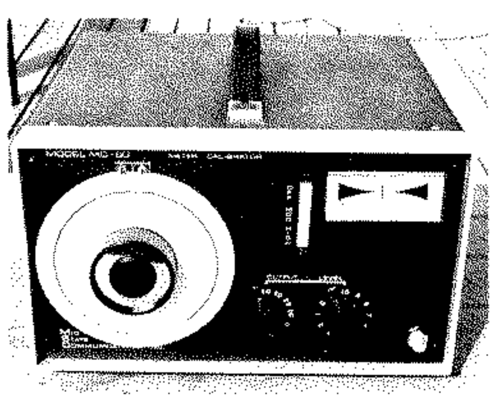
Because of the relatively high output level present (+50 dBmV maximum), the MC-50 will do duty not only as an SLM/FSM calibrator but as a general-purpose signal generator and as a variable frequency marker generator for your sweep-system testing.

The operating voltages within the unit are +/— 15 volts DC and +/— 7 volts DC. The +/— 7 volt DC supply is primarily to run the clock reference system; most of the innards function from the +/— 15 volt DC supply lines. The unit draws 40 watts on 115 VAC.

Questions/Answers

In our introductory remarks for this report, we asked questions about things such as "what are the real-life differences between CW carrier readings and modulated TV carrier readings?" And "how does the typical peak-reading detector meter handle these differences *at various detector input* (RF input) *voltage levels?*"

When the MC-50 was received at *CATJ*, we promptly set up the unit to check the operation of four different instruments we happened to have around the lab. The results of these tests are shown in table form. Note that we made comparative checks of the *difference in indicated absolute levels* for CW (AØ) carrier and video modulation carriers at *three points* for

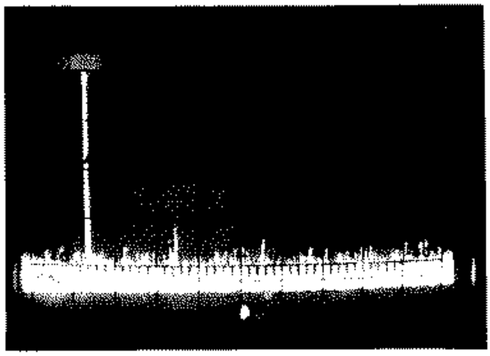


MID-STATE MC-50 Meter Calibrator/Signal Generator features built-in selectable video modulation each of the five instruments on hand. These checks are for indicated differences in level for CW and modulated carriers at −10 dBmV, 0 dBmV and +10 dBmV levels. These are *not* checks of the individual meter's ability to accurately read the absolute levels (we did that in November/January *CATJ*); this check is *only* for the *difference* in indicated levels for CW vs. modulated carriers.

A check of Table 1 clearly indicates that given this type of test procedure, *the various meters want to read less and less accurate* (i.e. the difference between CW and modulated carrier becomes greater) *as the meter-scale portion utilized is reduced*, with rare exception. In all cases, the meter scale was left intact; reading in the −10 to +10 dBmV region. The tests translate into *detector-efficiency errors*, and the errors typically become of progressively larger magnitude as the detector input voltage becomes *lower and lower*. This is *not* intended to be an across-the-board indictment of the meters (most *all* suffer, in varying degrees); we did that on an individual basis in November/January *CATJ*. This is intended rather to point up *the utility of the MC-50*, and *how* with this instrument you can either calibrate your meter properly for modulated TV carriers, or lacking the expertise or time to re-calibrate the SLM/FSM, at *least* develop a paste-on-the-instrument calibration correction table for *that particular instrument*.

S/A Display Puzzling

Naturally, we wanted to see what the effect of the CW carrier vs. modulated carrier switching would look like on a spectrum analyzer. So we trotted out the *Texscan VSM-1* (see January *CATJ*, Pages 41-50) and checked for (1) carrier stability when modulation was added (Mid-State says it will stay within 0.25 db), and, (2) harmonic output content of the MC-50.



VSM-1 DISPLAY of 50 MHz output from MC-50 (far left), 100 and 150 MHz harmonics; both are down more than 30 db (40 db log scale)

When the MC-50 was connected to the VSM-1 and the carrier level adjusted for full screen display on the VSM-1, the modulated signal was applied. Son of a gun, it appeared to us that the carrier level actually dropped, perhaps a db or so. Hummm. We tried it several different times at different input levels to the VSM-1 and finally decided the MC-50 had a problem; so we called Larry Dolan at Mid-State.

"Perfectly normal," said Dolan. *"The problem is in the VSM-1,"* he explained. *"How's that again?"* we asked, patting our VSM-1 lovingly. *"Look, the VSM-1 has a magnetic deflection system, and the yoke on the CRT display actually rolls off the response so that a 15.750 kHz modulation* (which is what the MC-50 uses) *waveform is down on the response curve of the yoke response. If you try the same test on a wide-band scope with just a quickie detector such as Steve Richey described in the March CATJ,"* said Dolan, *"you would see that the carrier level, with modulation present, does not deviate more than the 0.25 db we spec the unit at."*

Which we did, and which it did. But we thought we should mention this here because sure enough somebody out there would connect the MC-50 to a VSM-1 type machine and immediately assume the MC-50 was not holding a constant output (+/— 0.25 db) when 15.750 kHz modulation was switched on.

Now Mid-State specs the harmonic output content of the MC-50 at -30 db reference the desired frequency carrier, or better. Because harmonic output content has some bearing on the useful output energy level which the SLM/FSM sees for *calibration* purposes, we checked this with the VSM-1. The photo shown here depicts the primary output signal at 50 MHz, and the harmonics at 100, 150; no harmonics above the third at 150 MHz could be detected on the VSM-1.

As Mid-State points out, the MC-50 is calibrated on a power meter (as all reference signal generators must be), and through adequate precautions with bandpass filters between the MC-50 output and the power meter input, the effective power level present from any harmonics of the fundamental (desired) frequency is for all practical purposes *ignored* by the power meter; such energy is just too far down on the skirt of the MC-50 plus bandpass filter combination to have a consequential influence on the accuracy of the power meter indicated level present.

Synopsis

At a time in our industry when many suppliers are hesitant to invest in new product - research - and - development time, it is refreshing to see not only *the development* of a new product such as the MC-50, but to note with some pleasure that the whole project and product turned around from a *CATJ* query on Page 29 *in January* to a working, production box *in late March!* Now with that kind of dedication and creativity, the CATV industry will be around for a long long time to come!

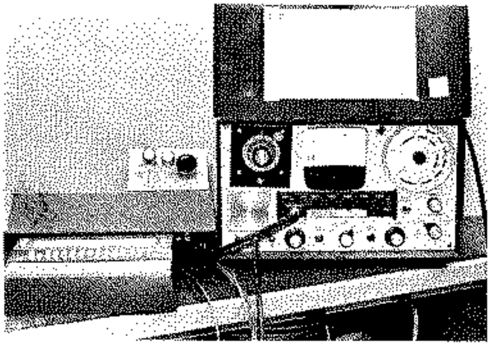
LOW COST S/A—IN JULY

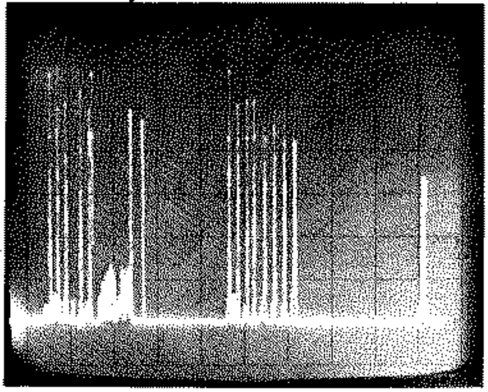
The July issue of *CATJ* will include a detailed report prepared by Jerry Laufer, Engineering Manager for Gill Cable, Inc., San Jose, California, on building your own spectrum analyzer.

No big deal—Jerry has taken a Jerrold RCS-3 home converter, a signal level meter and a (we show you how) shop-built sawtooth generator and plugged them all together into a smooth running package that with your shop (DC) scope makes a spectrum analyzer. Total cost—perhaps $50.00 if you have the basic sub-parts.

The July *CATJ* will tell you all about this reader-developed piece of test equipment, including complete construction details, board layouts and numerous photos of the device, interconnections and scope screen displays of the box(es) in operation.

If you want to prepare for it, run down your local Jerrold man and talk him out of an RCS-3 converter for a "test sample".





COLOR-ADDER CONVERTS WEATHER / MESSAGE CHANNELS TO RED, WHITE, BLACK DISPLAYS

Red Is Bright

If your black-and-white weather channel has been plugging along for months or years with no more attention than most...and if you are looking for a way to liven up the channel (short of running "X" rated slides at the end of the scan), here is a quick and easy rainy-day project that will turn your whites and grays to a better shade of pink (or red).

The *Color Adder* is a simple "fool the television set" box that plugs into the coax line between the output of the vidicon camera (video output) and the input to the CATV channel modulator. It operates on the principle that for there to be color reaction in a color receiver, the "transmitter" must radiate a 3.58 MHz (rounded off) sub-carrier. So the Color Adder does just that: it generates a 3.58 MHz carrier which is mixed (or added) to the vidicon camera video output on the way to the channel modulator. At the customer's receiver, the receiver detects the presence of the 3.58 MHz (sub) carrier, believes it is receiving a color sub-carrier, and immediately turns on the color guts of the receiver. In the process, anything the vidicon camera sees becomes subject to the 3.58 MHz (sub) carrier; the net result is that the so-called gray scale from just a shade darker than white all of the way up to dark gray becomes a shade of red (or pink if you will).

In addition to getting a white (more about that shortly), pink to red and black display *from a black-and-white camera*, it is the observed opinion of several system operators who have tried this circuit that you can sharpen up the black-and-white detail of the vidicon camera picture display on a color receiver by running the Color Adder at a low level, too low to actually provide a color tint on the grays.

by:
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One IC

There is not much to the circuit; it goes easily into a mini-box. The basic circuit is nothing more than a *1702 Quad two input positive NOR gate* IC device. Added to this (see Diagram 1) is a 3.579 (etc.) crystal (commonly available these days), and a small handful of miscellaneous junk-box-type parts. A 500 ohm pot allows you to control the level of 3.58 MHz injection from the oscillator to the through line of the vidicon camera video.

Construction is simple, and all parts should be available locally. The type 402 trimmer is a 5-25 pF mica compression trimmer; any other variable capacitor that will tune this range should

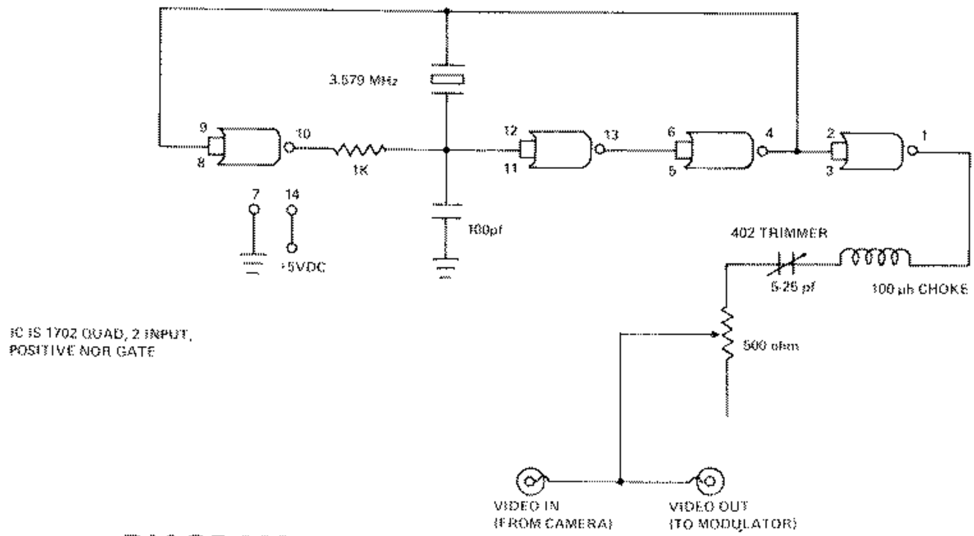
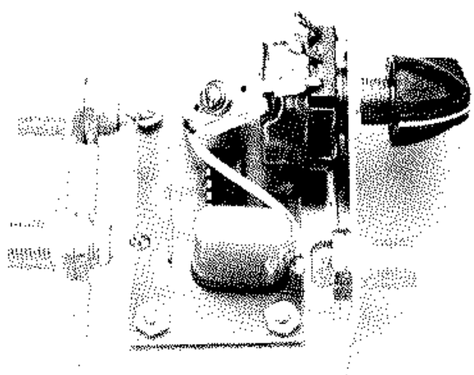


DIAGRAM 1

do the job. If you want to put together a PC board, a foil side layout is included here, actual size. Simply use it as it appears in CATJ to expose your own board. Or, you can wire the unit up as shown on an appropriate IC socket with hard wiring.

The power requirements are very minimal: 5 volts DC is required. Use the schematic shown in Diagram 2, or voltage drop from any standard 6 volt supply you may have kicking around. Even a battery source will do, although the battery life will not be very high.



Installation is very simple: *insert the Color Adder into the video line* from the camera on your weather channel, message channel, etc. as it goes to the CATV channel modulator. The 500 ohm pot in the Color Adder is used to control the amount of 3.58 MHz oscillator signal that enters the modulator along with the vidicon camera video information. And this is another way of saying that as you vary the 3.58 oscillator signal level, upwards, the amount of color showing on the receiver increases. It has been noted that if you crank in *just enough 3.58 oscillator* to key on the receiver color circuits, but *not quite enough* to start the tinting process, the quality (i.e. definition) of the black-and-white (untinted) image on the weather (message) channel improves noticeably. Apparently the TV receiver likes the presence of

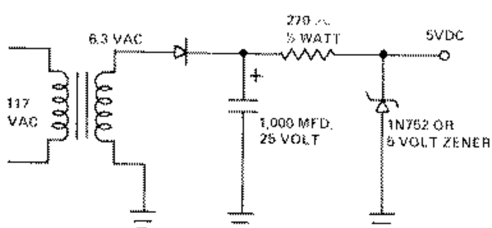
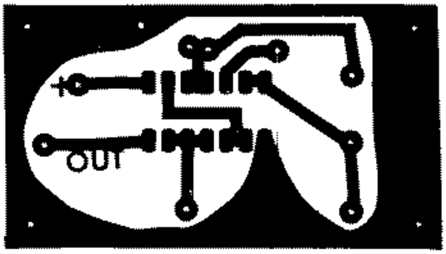


DIAGRAM 2



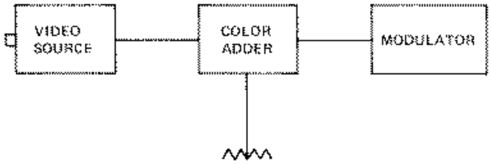


DIAGRAM 3

the 3.58 sub-carrier, and the video detector and associated receiver video amplifier circuits perform better with the color oscillator switched on. As you go beyond the point where the 3.58 MHz receiver oscillator just keys on, the amount of red tint to gray objects, backgrounds, etc. increases. You never reach a full red (unless you kill the vidicon camera video level and have just a blank raster; then you have a bright red!), but with the 3.58 level set by the 500 ohm pot in the Color Adder at a point where white areas *just start to take on a pink tint*, the gray scale (from light gray or off white to dark gray, or almost black) tint up from light pink to dark pink, respectively.

A really critical person would notice that with the Color Adder on, white (i.e. *pure* white) is no longer possible; it takes on a slight pink tint. This may or may not be to your liking. Of course you control the amount of pink from light to dark with the 500 ohm pot, but this is a subjective thing that every CATV-connected set in town will have to cope with on their own as they discover your new toy and start cranking around their own "tint controls" looking for blues and greens!

One way to make the whites come back is to design a diode level detector that senses the presence of pure white (maximum video level), and operates a FET switch to turn off the 3.58 MHz oscillator when full white is diode detected. This would allow you to run the gamut from black to reds to pure white with not much more invested than the simple Color Adder circuit shown here. This has not been done to date by the author, however, simply because we are still in the "Gee, look at those red pictures" stage.

One fellow we know got so carried away when he built up his own Color Adder that he directed his secretary to go down and purchase some Hot Pink lipstick. After applying the lipstick (to her, not him!) he ordered her to plant a big set of lip prints on the face of several of his weather instrument glass covers. Now when the camera pans the instruments, the background of the white meter is very slightly pink, the lettering and needle are black, and standing out there in front are two "Hot Pink Lips."

Whatever turns you on!

CABLE DROP

OOPS

The May issue of CATJ, Page 11, contains a schematic drawing of C-COR's basic standby power station and the interconnection for same. In the diode bridge, the diode on the **southeast** quadrant (up is north) is reversed 180 degrees. Turn it around or it will self-destruct. This error was in CATJ drafting, not C-COR presentation.

The same May issue, Page 34, glibly discusses the proposal that the 1050 sweep machine could be externally "jacked" for direct DC powering from the cable system amplifier; or "jacked" for powering from the 30/60 VAC line supply. Actually, DC powering will not fly because there is no 60 cycles for the sweep horizontal drive to the scope. But a manufacturer could provide a tapped 1050 (etc.) AC transformer in their unit which would accept 30/60 VAC as well as 110 VAC and the scheme would work.

ANTENNA BASICS (Part One)

What It Is

Antennas play such an important role in our everyday CATV lives, a basic understanding of what they are and how they perform is essential for every level of CATV personnel.

Most TV receivers have built-in antennas. Many of our CATV-connected homes have (or had) rooftop antennas. And we have antennas. Short of cable-connecting directly to the signal source (i.e. the transmitter), the antenna is an inescapable part of the broadcaster-to-receiver equation.

There are two antennas of concern in the broadcaster-CATV equation: the antenna utilized by the broadcaster to reach us, and the antenna employed by the CATV system to inter-connect the broadcaster's signal with our cable distribution facility. The broadcaster's antenna is fixed, and beyond our control. Our antenna on the other hand is as flexible and variable as our finances and physical surroundings will permit.

Any antenna is an electrical circuit of a special function. An antenna is a resonant circuit; that is, the combination of all of its physical parameters results in the antenna providing peak or maximum performance in a specific frequency range. In this regard it does not differ markedly from an amplifier circuit. An amplifier circuit utilizes a combination of inductance (coils), and capacitance (capacitors) to determine a resonant (or operating) frequency for the amplifier. There are broadbanded amplifiers (i.e. covering a wide range or band of frequencies), and there are narrow-band amplifiers (i.e. covering just a single TV channel, as in CATV). The circuit designer of the amplifier "plays" with the parameters (inductance and capacitance) until he achieves the desired (design intended) results.

Now a coil and capacitor combination resonant on (say) channel 2 is quite small. You can hold it in the palm of your hand with ease. Yet it is design-intended for channel 2. A channel 2 antenna, on the other hand, is much too large to be held in the palm of your hand. And the difference is this.

The dimensions of the coil(s), capacitors, and connections in a channel 2 (amplifier) *resonant circuit are so small,* as compared to the actual physical length of the channel 2 wavelength, *that radio frequency (RF) energy in the circuit is primarily utilized in the performance of the circuit goal* (although some is dissipated as heat).

However, if the circuit designer begins to "play" with the characteristics of the resonant circuit, increasing the inductance (L) of the circuit so that the physical dimensions of the "circuit" become large(r) as compared to the actual physical length of the channel 2 wavelength, *some of the energy in the*

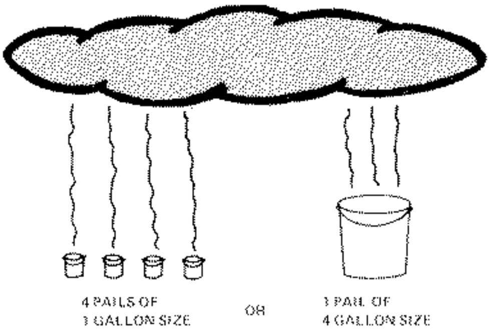


DIAGRAM 1

circuit escapes from the circuit *by radiation* of electromagnetic waves.

Generally speaking, the amount of signal voltage intercepted by an antenna standing in the atmosphere is a function of *the size* of the antenna. For our purposes, it is convenient to visualize the signal transmitted by the broadcaster as being omnipresent (everywhere at the same time). We of course know that broadcast signals *are not equally present* behind buildings, hills, or in valleys. But within a *small area*, such as at our headend site or within the cone of influence of our tower support structure, we can *for all practical purposes* conclude that the signal we are desirous of receiving is available anyplace we might happen to mount an "antenna."

So it is also convenient to view our receiving antenna problem as one of obtaining sufficient "signal flow" (i.e. voltage) to meet our minimum requirements for signal strength (level). And for our purposes, we can draw an analogy between our antenna system and a water catchment system (see Diagram 1). Visualize each antenna as a pail set out on the ground to collect rain water. The more pails, the more water collected. Or, the more antennas, the more signal collected. Or, if four small pails make less sense than one big pail, where the sum of the open-face diameter openings of the four pails would be the same as the open-face diameter of one larger pail, then it may be more convenient to catch our water (or signal) with one large pail (antenna) than four small pails (antennas).

Constants

In an electrical circuit that has resonance at a particular frequency, the inductance (L) of the circuit is primarily concentrated in the capacitor, and the resistance of the circuit is spread throughout both of the L and C concentrations, plus throughout the connections of the circuit. This is called *lumped constants*, because two of the most important ingredients which determine operating frequency are bunched (or lumped) together in singular circuit locations.

In an antenna circuit, the inductance, the capacitance and the resistance are spread rather uniformly throughout the whole body of the antenna. This is called *distributed constants.*

In an antenna circuit there is both resistance and reactance. The largest received signal voltages will be present when the resistance of the circuit is tuned out, or minimized. Which is another way of saying that largest received signal voltages will be present in a given antenna system when the system circuit is tuned to resonance at the operating frequency.

Resonance

If the voltage we desire from the signal we are receiving is our primary concern (and it is), we need to know a little bit about the resonance characteristics of antennas.

DIAGRAM 2

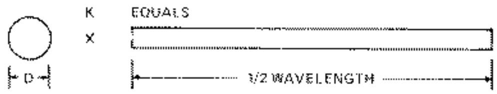


DIAGRAM 3

As shown in Diagram 2, the shortest antenna-conductor which will tune to resonance is a ½ wavelength antenna (the actual antenna material may be any conductive medium, including wire, tubing, etc.). A ½ wavelength antenna is just long enough so that the electrical impulse on the desired frequency will travel from one end of the antenna-conductor to the opposite end, and back again in the time it takes for one RF cycle to pass.

Calculation of this "shortest practical length" is relatively simple. For all practical purposes, RF waves travel at the speed of light, or 300,000,000 meters per second. Therefore the distance which the signal will cover along a perfect antenna structure is equal to this velocity divided by the frequency:

$$\text{½ wavelength} = \frac{300{,}000{,}000}{f}$$

where the answer is in meters and f is the frequency in hertz. This can be numerically shortened by using the derived formula:

$$\text{½ wavelength} = \frac{492}{f\ (\text{MHz})}$$

where instead of meters we have the answer in feet.

Now these formulae *assume* that the RF wave will travel *along the surface of the antenna with the same velocity* or speed as it will in air. The facts are that this will not happen, because the dielectric constant of the antenna materials is always greater than the equivalent air constant. Which is another way of saying that the surface resistance of the antenna material(s) *acts to slow down the speed of the wave* passing along it. The net result is that when you design an antenna that is corrected for the dielectric constant of the antenna materials, you have an antenna that is physically shorter (smaller, etc.) than a paper-designed antenna that assumed ideal conditions.

So you must correct for the effects of the antenna materials, and you do this by modifying "492" in the ½ wavelength formula just given by some correction factor (call it k). The formula then becomes:

$$\text{½ wavelength} = \frac{492 \times k}{f\ (\text{MHz})}$$

and now we must determine what value to assign to k.

K, as a physical-length-correction-factor, is dependent upon the ratio of the antenna surface conductor length to its diameter vs. operating frequency. *See Diagram 3.* As this *ratio becomes smaller and smaller,* the more the physical antenna we are constructing *must shorten to compensate* for an increasing surface area of the antenna element.

Another way of stating this is to note that as antenna construction materials increase in physical diameter (size), the greater the shortening effect on the physical length of the antenna itself. In actual practice, antennas constructed in the VHF/UHF region with antenna elements of 0.25 to 2.0 inch diameter often are as much as 5-7% shorter in real life than the same antennas would be if constructed from #12 wire (for example). The final result of taking into consideration the "k factor" is yet one more (and more final) formula for determining the actual length of a resonant antenna for VHF and UHF frequencies. Because antenna-elements lengths tend to become quite small at VHF and UHF frequencies, it is usually more appropriate to reference lengths to inches rather than feet/meters and fractions decimal fractions thereof. The formula therefore becomes:

$$\text{Length (in inches)} = \frac{5905 \times k}{f\ (\text{MHz})}$$

although this still leaves us unsure of the influence of "k." Reference is made

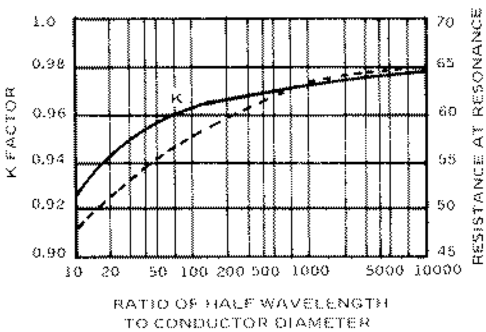


TABLE 1

to Table 1 here which indicates a value for "k" based upon the ratio between the antenna-element diameter (in inches or fraction thereof) and the free space ½ wavelength for a particular frequency. Table 2 here indicates the practical effects of 0.25, 0.50, 1.0 and 2.0 inch outside diameter elements on a resonant ½ wavelength dipole for channel 2 (55.25 MHz), 7 (175.25 MHz), and 14 (471.25 MHz). As is evident, antenna physical length is progressively determined as the frequency rises by the diameter of the material utilized in the construction.

Finally, if all of this seems too pure for average everyday application, there is a formula which can be employed *to determine the length of the dipole element with reasonable accuracy*, which includes an "average" value for the k factor. It is:

$$\text{Length in inches} = \frac{5540}{f\ (\text{MHz})}$$

Matching

A resonant antenna is, as we have seen, resonant on one single frequency. And that frequency is the sole frequency where RF energy, encountering the antenna, will travel from one end to the opposite end, and back again, in precisely the time it takes for the RF carrier wave to go through one complete carrier cycle. To put that into perspective, at channel 2 there are 55,250,000 cycles of carrier wave per second (while at channel 14 there are 471,250,000 cycles of carrier wave per second).

Having the antenna resonant is the first requirement, because resonance correlates with maximum energy transfer from the transmission medium (air) to the antenna collector (dipole). The next requirement is matching of the impedance of the antenna to the transmission line. Antenna resonance is important to the transfer of electromagnetic energy from the air-transmission-medium to the antenna, and antenna impedance matching to the impedance of the transmission line is equally important for transfer of the antenna-captured energy to the transmission line link to our receiving equipment.

No basic dipole antenna is just *automatically* 75 ohms, unbalanced. Yet our most standard transmission line format is exactly that. Therefore *to couple the maximum amount of antenna-dipole energy out of the antenna and into the transmission line* requires some type of impedance matching network.

Impedance transformation projects immediately run into two separate but related problems. The first and most obvious is the matching of a 250 ohm antenna impedance (*for example*) to a 75 ohm transmission line impedance. The second, and not quite so obvious, is the common antenna design practice of *balanced antennas*, and the almost universal-in-CATV employment of *unbalanced transmission* lines.

TABLE 2

	Free Space	0.25"	0.50"	1.0"	2.0"
Ch. 2	8.90'	8.63'	8.59'	8.54'	8.46'
Ch. 7	2.81'	2.70'	2.68'	2.67'	2.61'
Ch. 14	1.04'	1.03'	0.98'	0.96'	0.95'

Impedance transformation is a transformer type of problem. You have on one hand a known impedance of "X" value and on the other hand a known impedance of "Y" value; and to couple maximum energy from "X" to "Y," you need a matching transformer not unlike those we hang daily on the back of customer receivers. Or you need to employ some special matching tricks that are usually *peculiar to antenna systems* (i.e. they are not practical for behind-the-set devices).

Balanced to unbalanced matching is a variation of the first problem, and often both portions of the problem can be tackled so that both are solved simultaneously.

For now we will stay with the basic antenna, the "dipole." See Diagram 4. This dipole antenna, adjusted to resonance by tuning the length to exactly ½ wavelength overall (with k factor included), is nothing more nor less than a straight metal rod of conductive material. Connecting the 75 ohm CATV transmission cable to the dipole element is no easy trick!

We have the following options available:

(1) We can break the ½ wavelength rod into two exactly equal parts, placing an insulator in the center as shown in Diagram 4-A; and treat each of

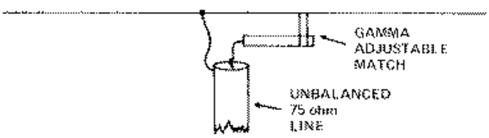


DIAGRAM 5

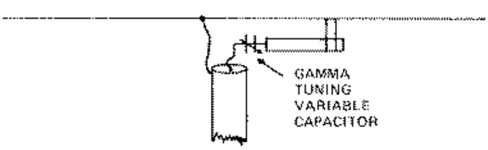


DIAGRAM 5-a

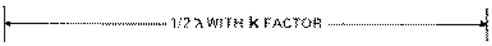


DIAGRAM 4

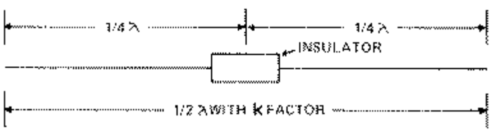


DIAGRAM 4-a

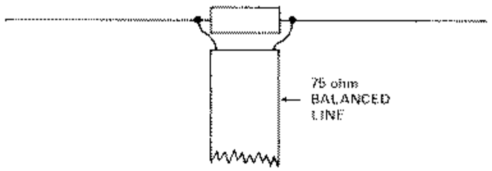


DIAGRAM 4-b

the two portions as equals. In this case, equal ¼th wavelength elements.

(A) This can be fed with balanced 72/75 ohm line, such as 75 ohm twin-lead, directly, and a good match will result.

(B) This cannot be fed directly with unbalanced 72/75 ohm line, such as RG-59/U, .412, etc. because the balanced antenna will not present an unbalanced 72/75 ohm load to the unbalanced 72/75 ohm coaxial cable.

(2) Or, we can leave the ½ wave element intact and;

(A) Connect the shield of the coaxial cable directly to the center of the ½ wavelength rod (same point as broken at center in [1] above), and through a matching arrangement known as a gamma match (see Diagram 5), in effect *tap along the dipole element* until the correct point is found where the

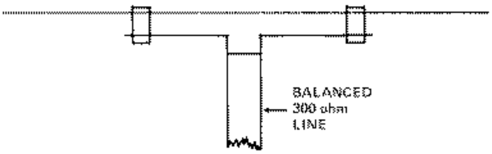


DIAGRAM 6

unbalanced impedance of the transmission line equals or matches the *unbalanced impedance of the off-center-fed* dipole element.

To tune out residual reactance, a series tuning capacitor is added to the matching system as shown in Diagram 5-A; capacitance values of 50-75 pF are typical for low-band channels; 10-20 pF values are typical for high band.

(B) Using an approach known as the T match, as shown in Diagram 6, the basic resonant dipole is parallelled for a portion of its run by a second set of shorter antenna elements, which short or connect to the basic antenna element with sliding adjusting clips. The bottom, shorter section, *is broken in the center and fed with 300 ohm balanced line.* At some point equidistant from the center of the main antenna element, both shorting bars self-adjust to produce the best match for the antenna element to 300 ohms, and maximum energy transfer takes place (i.e. best match). Of course this still leaves you at 300 ohms antenna - feed - impedance, but that happens to be a value fairly easily dealt with, using commonly available 300 ohm to 75 ohm matching transformers.

Actually there are probably a dozen more "matching schemes"; names like the omega match, the hairpin match, the beta match, delta matching, quarter-wave transformers, bird-cage dipoles, matching stubs, and bazookas are commonly found in antenna system design literature. All have applications in specialized antennas but are not commonly found in CATV antenna designs, for reasons to be discussed.

Any matching scheme is merely an electrical approach to what is basically *a mechanical problem.* When we have a 75 ohm circuit in an amplifier looking into a 200-300 ohms circuit in a following stage, we grab a torroid coil, wind a few turns and create a transformer. This is not always *the best mechanical answer* for the antenna, because of the problems associated with maintaining antenna performance in all manner of ice and moisture loading. So antenna designers must work around the basic impedance and balanced/unbalanced "problem" while searching for a solution that will hold up in foul weather.

Any individual doing his own "antenna playing" has about all that he needs to experiment if he has a relative signal level instrument (SLM/FSM) and a constant signal source (i.e. line-of-sight TV transmitter). *Simply tune for max!*

Multi-Element Arrays

Unfortunately for us, a dipole antenna is seldom (if ever) sufficient antenna system for our needs. We usually need (1) more gain, and, (2) greater directivity than a simple dipole antenna.

The dipole antenna has *such low gain* that a good portion of the antenna industry utilizes it as a *reference.* Antenna literature which specs model "XYZ" antenna *gain* as 12.3 db "to a reference dipole" means simply that the antenna in question produces 12.3 db gain above a dipole antenna tuned to resonance. Because it is fairly easy to build duplicate dipole antennas in Portland and Atlanta, *and perform tests against the reference dipole as a standard,* thereby producing meaningful comparative test results, the dipole in CATV primarily is utilized for reference. Even FCC radiation level tests (see CATJ for December, Page 25) are easily referenced to levels as measured with a dipole reference antenna.

A dipole antenna has a cloverleaf, or doughnut-shaped response pattern; see Diagram 7. That is, if the ends point north by south, the antenna has maximum response (i.e. gain) east and west, or at 90-degree angles to the direction of the antenna elements. The radiation pattern of the dipole is not only east and west however, it is also up and down as shown in Diagram 8. In other words, it has a circular "doughnut-shaped" configuration; when mounted sufficiently high above the real ground as to be free and clear of ground distortions to its so-called "free-space" pattern.

This doughnut-shaped response and the east and west cloverleaf pattern shown in Diagram 7 can be modified, however, by enlarging the "field" of the antenna with non-active elements; or with additional frequency independent elements.

An element (or any elements) that are directly connected to the transmission line are called active elements.

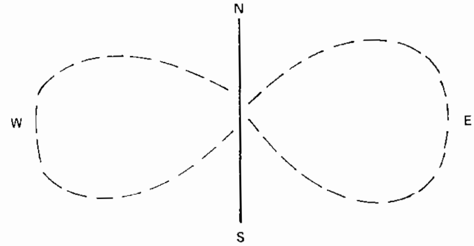


DIAGRAM 7

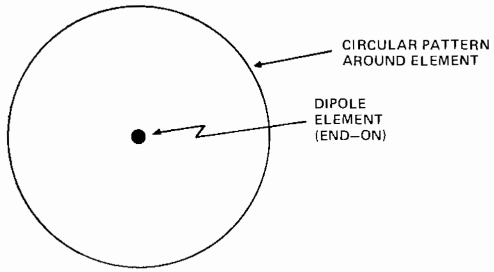


DIAGRAM 8

That is, they collect received signal energy for the express purpose of transfering that energy into the transmission line. On the other hand, elements in the field of the antenna which are not directly connected to the transmission line are called parasitic elements. Their contribution to the antenna performance is largely concentrated *within the field of the antenna,* but they are parasitic to the actual signal-collecting process.

Unfortunately, *any parasitic element brought into the "field" of the antenna* produces instant and measurable changes in the *antenna impedance,* as well as changes in the *antenna pattern.* For example, a dipole antenna pruned to resonance as previously discussed, and matched for maximum transfer of its energy to a 75 ohm downline will suddenly become less effective if a *single parasitic element* is placed within the dipole field. If the element is longer than the dipole element, it is called a reflector and the resultant pattern change will look like Diagram 9. Or, if the new element is shorter than the dipole element, it is called a director, and the resultant antenna pattern change appears as Diagram 9-A. In this case, the addition of a reflector (longer) element *re-structures the antenna pattern so that pickup from the rear* (i.e. through the reflector towards the dipole) *is reduced.* In effect, signals entering *through the reflector* are reflected away from (or shielded from) the dipole element by the presence of the reflector. A yagi

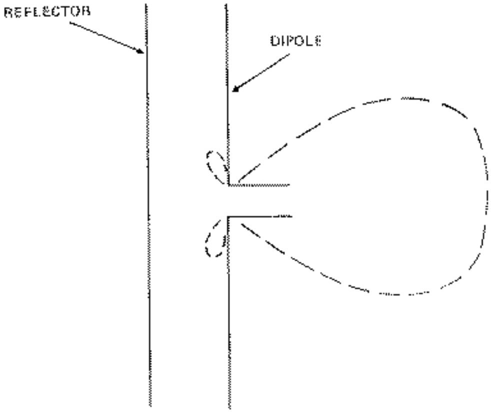


DIAGRAM 9

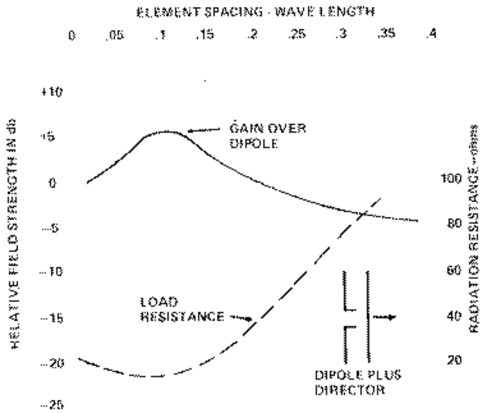


TABLE 3

antenna achieves *most of its front-to-back ratio* from the presence of one or more reflector elements in the field of an antenna. The addition of the director, on the other hand, *sharpens the forward pattern* (i.e. *through the director* to the dipole element) through an effect *similar to focusing.* This process reshapes the receiving pattern of the dipole *in the direction through the director,* but leaves the receiving pattern essentially unchanged through the rear (i.e. directly *to the dipole* element without passing through any other element).

The addition of a reflector, or a director, *to the basic dipole antenna element* is virtually guaranteed to *lower the real-life impedance* of the dipole. How much the impedance of the dipole is lowered depends to a large extent on the distance between elements or amount of coupling between the two elements (whether the second, or parasitic, element is a reflector *or* a director).

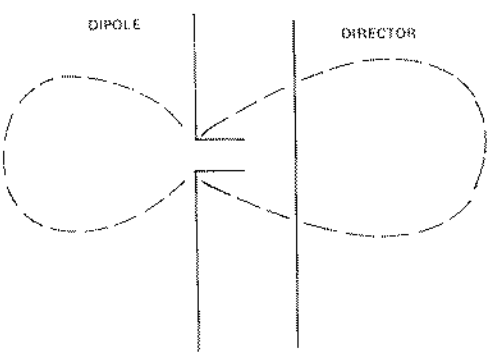


DIAGRAM 9-a

The addition of a director or reflector is also guaranteed to have an effect on the length of the dipole element (and vice-versa, although we will ignore the effect on the parasitic elements for now).

Consequently, *the addition of even one parasitic element* into the field of a dipole antenna becomes a complicated, inter-related kind of cause-and-effect situation. And all of the parameters change each time you "play" with the (1) spacing between the two elements, (2) length of any single element. In fact, the addition of metal into the field of a parasitic antenna (or log/active antenna) and associated effects is not confined to the *immediate plane of the antenna,* if you are looking for (or seeking to avoid) cause-and-effect relationships. A well-honed channel 4 antenna system, *for example,* joined on the tower by a channel 2 antenna array can easily cause considerable changes in the previously monitored and measured channel 4 array performance; simply by placing the channel 2 array above or below (but still *within the field* of the) channel 4 array.

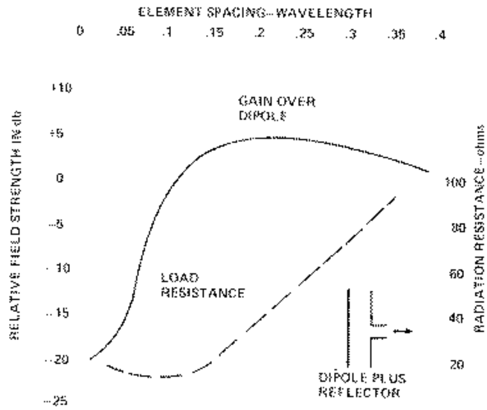


TABLE 4

Tables 3 and 4 and 5 indicate what happens to one particular form of two-element antenna (parameters) when the extra element (self resonant parasitic) is a director, or reflector; and if the spacing between the dipole element is varied with respect to the newly added parasitic element. It is no wonder that basic antenna design is often considered to be a black-magic art!

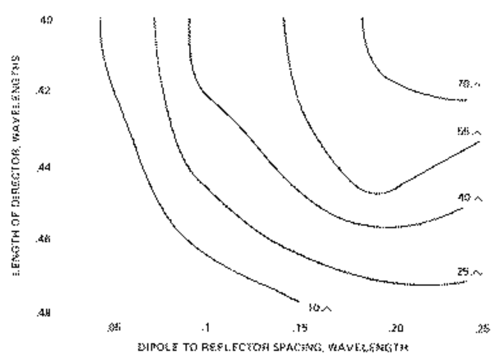
Three Element Array

Most of the *major changes* in the dipole characteristics take place with the addition of the *first parasitic element.* Which is another way of saying that after the first bite, the additional bites have less and less effect on the basic array as tuned to that point. Still, even with very long experimental yagi arrays of 10 or more elements, the designer continues to experience complex re-tuning procedures each time he decides to expand the array by a *single additional element.*

Naturally it is wise to determine why you would want to continue to increase the size of an array. Basically, you are trying to increase the capture area of the antenna, which is another way of saying "add gain." There is a point (or area if not a clearly defined point) where for CATV purposes *the number of in-line elements* on a single boom (stack) may result in less added performance than the additional weight, wind surface area and mounting difficulties can justify. Experimental VHF and UHF communication yagi-type antennas may have as many as 30 elements on a single boom; few CATV yagi-type antennas venture beyond ten elements per boom. We will explore why this is so next month.

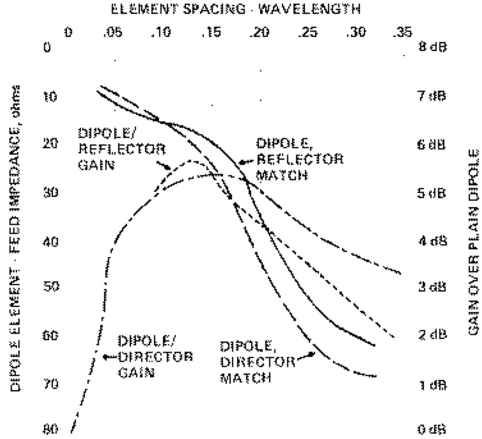
As you move beyond the second element (whether reflector or director was the second element added), the usual practice is to end up with *one each reflector, dipole, and director* with a three-element parasitic array.

The addition of the first parasitic element is usually for (1) increased front-to-back ratio (add a reflector), increased gain (add either a reflector or a director—both end up about the same) or increased forward pattern sharpness/selectivity (add a director). In any case, the addition of the second element is usually calculated for optimum performance in the desired area, which may be injurious to obtaining a



A three element yagi type antenna, with adjustable reflector to dipole spacing (bottom line of chart) and adjustable director length (left hand edge of chart) on a boom 0.3 wavelengths long will produce a 70 (75) ohm dipole feed impedance when the reflector to dipole spacing is approximately 0.21 wavelengths, and the dipole to director spacing is 0.09 wavelengths; with a director length of 0.42 wavelengths.

TABLE 5



Feed impedance at center of dipole element, for two element Yagi-Uda, as a function of inter-element spacings. Also shown is gain of dipole plus either reflector or director, as function of inter-element spacing.

CHART 3

good match from the two-element antenna *to the transmission line*. For example, as shown in Chart 3, the optimum gain for a two-element antenna with director is achieved when the director is between 0.1 and 0.15 wavelength in front of the dipole element. And optimum gain for a two-element antenna with reflector is achieved when the reflector is 0.15 to 0.2 wavelengths behind the dipole element. However, the impedance of the dipole element, as shown in Chart 3, with either director or reflector added, hovers between 20 and 42 ohms for spacings either side of the dipole element of 0.15 and 0.20 wavelengths. Obviously *matching to a 75 ohm transmission line is complicated by the addition of any singular extra element.*

However, when the antenna has a reflector, dipole, and director, there are spacing combinations where the dipole impedance can actually be brought back very close to 70 ohms (see Table 5). This is not to say that achieving a 70-75 ohm dipole feed impedance is the *only consideration* we must be concerned with; frankly, *it may be the easiest to correct* with antenna "pruning" after we have achieved the desired (1) front-to-back ratio, (2) front-to-side ratio, (3) gain, (4) control of minor antenna lobes. Still, it illustrates that *if you thought you had a handful of variables to play with, with a two-element antenna,* your variables just increased by 2X-3X when you added the third element! And any one of these variables can spell disaster, or success, for the designer who knows how to make them all play to his advantage when he is out to solve a particular receiving problem.

Next month we shall discuss beamwidths, bandwidths and practical antenna construction practices.

CATJ CONTEST FOR READERS

How well do you read CATJ each month? Could you handle a simple quiz on what was contained in this issue? How would you score?

Would you like to find out? We would. And to make the "game" just a little more tantilizing, we are going to give away prizes. Not your everyday hum-drum prizes either, but big prizes. Things like amplifiers, test equipment, antennas, processing equipment.

Sound too good to be true? Well keep your hat on, your pencil sharp and your mind alert because just around the corner (and down the lane) the **CATJ READER CONTEST** is lurking; ready to pounce upon your body.

We are currently clearing this "scheme" with the Post Office authorities (you think the FCC has red tape!!!) and we expect to announce the first contest in the August issue of CATJ.

Keep the faith.

Expand Your Test Abilities

SADELCO 260-A ANALYST IS A LOT OF MACHINE

More Than A Signal Generator

In the January *CATJ*, in the wrap-up portion of our four-part series on the present state of the art for SLM/FSM devices, we began a review of the *Sadelco* model 260-A Spectrum Analyst. At that time we noted that we were primarily dealing with the reference signal level functions of the 260-A and that in the future we would revisit this interesting piece of test equipment.

The future is now. And in the interim few months we have had the opportunity to work extensively with the 260-A and to talk with operators about it. Frankly, after using it, and talking with others about it, we wonder why system operators have so far managed to avoid the unit so extensively. The facts are that most system operators do not appear to know what the 260-A Spectrum Analyst does, or why it should probably be the first piece of test equipment they look seriously at after acquiring a quality SLM/FSM. Now that is editorializing, and we realize it; but the facts are quite plain after working with the 260-A, and we believe you will agree after reading this report.

One of the users of the instrument (a very well-known Canadian consulting group) uses the 260-A for checking out new (and old) sections of CATV plant; they use the broadband noise output mode (flat to within +/— 0.1 db on the unit we received for test and review, over the range 50-300 MHz) as a signal source, plugging the 260-A noise output into the section of plant they are checking, and then adjusting the response of that plant section an amplifier at a time with either an SLM or a portable spectrum analyzer, such as the VSM-1.

Another operator in California told us that his underground crew carries the 260-A around with them to check for cable faults in new sections of plant, using the 260-A with an SLM to calculate where shorts or opens exist. This is a procedure that involves using both the 260-A and an SLM/FSM to measure the frequency difference between standing waves on an open (or shorted) line, applying that frequency difference as a number to a chart supplied with the 260-A to ascertain the distance from the measurement point to the cable fault.

A service facility told *CATJ* they used the 260-A as a noise source with their FSM to check noise figures for pre-amplifiers and broadband amplifiers they service.

A fellow in Oklahoma checks out antenna match; numerous operators we talked to use the 260-A as a reference level to check calibration for the SLM/FSM units.

Yet for every person we found using the 260-A, we found perhaps ten or more who were not even aware of its applications. Many mistake the Sadelco phrase "Spectrum Analyst" to mean that the unit is similar to the VSM-1 spectrum analyzer (*it is not*). Others think it is merely a complicated SLM/FSM calibration source. One distributor we talked with volunteered that he has had three 260-A units in stock for several months, and "no movement indicated."

Finally, we talked at length in New Orleans with the 260-A's designer, Harry Sadel, and learned that he was seriously considering removing some of the functions from the 260-A (such as the bridge) as at least an alternative or option for the prospective buyer. "They are selling well in South Africa," noted Mr. Sadel, "but here they seem too complicated for the average system operator."

Recalling that television was brand new in South Africa and that anyone in the distribution business there was bound to lack our twenty-five-year (plus) backlog of technology, it seemed incredible to us that Sadelco might consider redesigning the "box" because the U.S. (and Canadian) CATV market was having a hard time appreciating what a versatile test instrument could be purchased for under $600.

Briefly...

The 260-A is a source box. It produces two types of signals; one is a precise (self-calibrating) 73.5 MHz crystal-controlled carrier at 1,000 microvolts (1 mV) level. This precise level is used as a reference source for both meter calibration alone and as a reference source to adjust precisely the second source generated by the 260-A. The second source is a wideband noise source; sort of an "everyplace at once" *sweep kind* of signal. Noise is an excellent reference tool, if you know (1) the exact level of the noise, and, (2) if the noise is spread out in frequency so that

SADELCO 260-A Spectrum Analyst has self calibrating CW carrier mode and wide band noise mode; battery charging system.

it covers all of the frequency range that interests you. That is basically what the 260-A wideband noise source is: *a precise level noise source* that extends from 4.5 MHz to 300 MHz, with incredible flatness (Sadelco says +/— 0.25 db over the range; *in the 50-300 MHz range* we were most interested in, we found +/— 0.1 db flatness to be the case).

A sweep signal has about the same characteristics for many applications, except the sweep source requires a scope for accurate display, and it is not really spread all across the spectrum constantly; rather it "sweeps through the spectrum" at some pre-determined rate. A sweep display system depends upon the persistence of the phosphor of the CRT display tube *to make it appear* that it is all across the desired spectrum at the same time. A wideband noise source simply *is every place at once*.

A sweep signal, even from the new Wavetek 1050, requires a little ingenuity to move around quickly any place in the plant. The 260-A, operating from its own internal rechargeable battery source, goes with you any place that you require a wideband signal to plug into a section of plant.

The 260-A will:

(1) Calibrate field strength/signal level meters;

(2) Measure amplifier gain, passive loss and active or passive response curves with a conventional SLM/FSM as a read-out tool;

(3) Generate the aforementioned wideband noise source for amplifier tilt and gain checkout, again with an FSM/SLM as a read-out tool;

(4) Measure return loss and allow you to calculate VSWR with the same SLM/FSM as a read-out device;

(5) Determine the location of cable opens or shorts, from as much as 500 feet of cable away;

(6) Measure the noise figure of broadband or single-channel amplifiers, again with the indispensable assist of a SLM/FSM;

(7) Provide a crystal-controlled signal source of 73.5 MHz (others are available if 73.5 MHz bothers you) to plug in at the headend for checking your system radiation compliance for annual FCC tests.

That, briefly, *is what the 260-A can do for you.*

Substitute For Sweep?

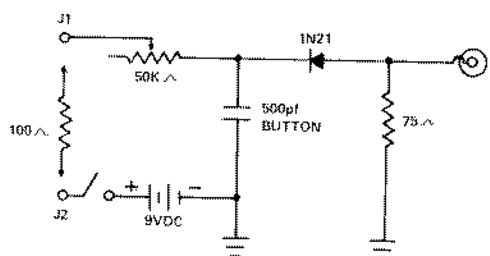
Many of these functions possibly sound suspiciously like the extra measurement assists you get when you expand your own system's test equipment to include a wideband sweep test setup.

Although we have never discussed this with Harry Sadel, we suspect that the same thoughts occurred to him during the course of his development period for the 260-A. On the assumption that you already have an FSM/SLM in your shop, and on the presumption that you find situations where the signal or field strength meter is just not enough test equipment to maintain your plant properly, you probably have given some thought to investing in (1) a sweep, (2) detector, and (3), a scope.

We talked about this in the May *CATJ* (see *Wavetek 1050* Review, Page 31, May).

A fairly powerful argument could be made for the 260-A in the same vein. In practical use, the 260-A calibrated wideband noise source can do many of the things which the sweep generator can do. The detector and scope you need with a scope are already on hand: in your FSM/SLM. Now it should be noted that a sweep, detector, and scope *will let you see and detect things* that you *cannot* see and detect with a 260-A, and the primary reason for this is the *limitations of the SLM/FSM* as a read-out device. Close (tight tolerance) work, such as measuring the precise rate of roll-off of a bandpass filter, for example, is going to be a lot cleaner, quicker, and perhaps more accurate with a sweep, detector and scope than with a 260-A and FSM/SLM. The broad (relatively speaking) i.f. response of the SLM/FSM is the culprit here: it limits the "definition" you can measure accurately with the 260-A as a wideband signal source.

So *there is a trade-off* in the mind of anyone considering the usefulness of the 260-A versus the limitations; and



Typical VHF noise generator. Jacks J1, J2 allow measurement of diode current (2 mA max typically). Mount 75 ohm load resistor directly to output jack with very short leads. Mount noise diode to 75 ohm load resistor with very short leads, and button (mica) 500 pF is also mounted with very short leads. 1N34 diode not satisfactory for VHF use.

DIAGRAM 1

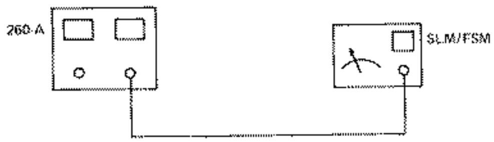


DIAGRAM 2

the expense of adding the 260-A versus the expense of adding whatever components you need to be in the sweep business.

As a Wide Band Source

Many of the straightforward applications of the 260-A revolve around the oft-mentioned wideband noise source. In the simplest form of noise generator, a diode is made to draw current, and it therefore creates noise. The noise generated by a "diode drawing current" is in the main limited by the circuitry employed with the diode. A *sample* (not 260-A) wideband noise source schematic is shown in Diagram 1.

A diode drawing current emits controllable amounts of noise, over a controllable spectrum width, through circuit tricks, the flatness of the wideband noise generating diode circuit can be held to very tight tolerances. The level of the noise can be controlled by controlling the amount of current drawn by the diode. Or, the diode can run wide open at a fixed current, and the actual output level of the noise source can be step attenuated in 1 dB steps with precision step attenuators.

The 260-A has a maximum wideband noise output of +10 dBmV (for a .5 MHz SLM i.f. bandwidth); this is controlled down to —10 dBmV in 1 dB steps with the front-panel step attenuators. For most applications, a wideband level of +10 dBmV would be adequate. For those special circumstances where it is not, the noise can be fed into a post amplifier to achieve additional level (amplification) to whatever level is desired and the post amplifier(s) can handle. It should be noted that if you are going to use the 260-A for line amplifier balancing, the +10 dBmV is in the right ball park for many amplifier recommended inputs.

Calibration (if exact level calibration of the wideband source is required) is handled by switching the 260-A to the narrow-band (CW) position. Here it produces a self-calibrated (+/— 0.25 dB) 73.5 MHz carrier which is utilized with the aid of your SLM/FSM to calibrate to a 0 dBmV reference level. From here it is simply a matter of sliding attenuation out of the slide attenuators to reach the desired level (up to +10 dBmV or down to —10 dBmV).

Diagram 2 indicates how the 260-A plus SLM/FSM is connected to calibrate the signal level meter. Measuring gain, loss, and response is shown in Diagram 3. The procedure for Diagram 3 is almost the same in each case.

(1) The wideband source is checked for its own level, as read out by the SLM/FSM;

(2) The wideband source is then fed into the device under test, and the SLM/FSM connected to the output port of that device;

(3) If you are measuring gain (amplifier) or loss (filter, DT, splitter, etc.), simply note the difference in reading between the 260-A direct to the SLM/FSM and the reading through the device under test. If the device is frequency sensitive (i.e. selective), simply tune the SLM/FSM either side of the device's design frequency and *note the difference* in readings. You can plot this on a piece of graph paper to compose a quick and simple chart of the "response curve" of the device being "swept" with the 260-A and the SLM/FSM.

(4) If the device under test has a built-in tilt, the *wideband flat output* of the 260-A fed into the device will allow you to quickly verify the true tilt of the device. Simply jot down the SLM readings made through the under-test device as you "sweep" the SLM/FSM from 50 to 220 MHz (or over whatever range is of interest) and jot down the levels. Transpose these to a piece of linear graph paper found at the corner drug store, and you have a visual presentation of the device response.

The same procedure will work for pre-checking out rolls of cable; drop or plant. Simply feed the 260-A into one end of the reel and connect the SLM/FSM to a connector on the opposite end. Plot the readings on a piece of graph paper. Because the output of the 260-A is flat, any deviations from a flat output as read through the roll of cable are due to cable tilt (roll-off) as frequency increases, or dips and valleys are due to *cable continuity problems*. Better to find out at the shop than after installing 2,000 feet of the stuff!

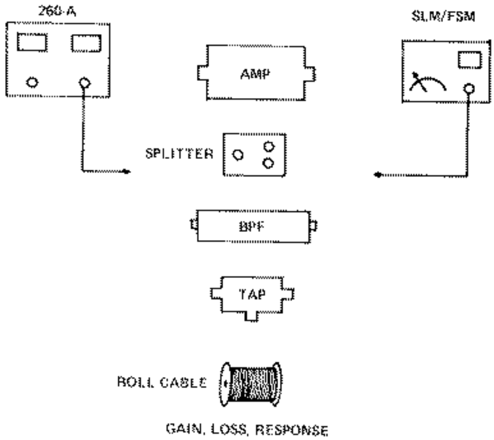
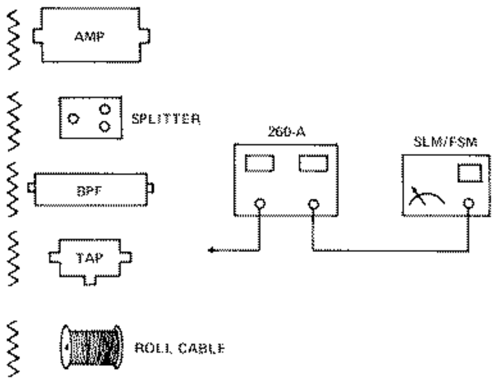


DIAGRAM 3

And A Bridge

In a transmission system at VHF (i.e. *transmitter loading into a transmission line connected to an antenna*), the *efficiency* of the transmission line and antenna are commonly determined by inserting into the transmission line a device known as a "bridge." A bridge is an instrument that (usually) measures the amount of transmitter power flowing *from* the transmitter *to* the antenna, and also measures the amount (or percentage) of power *not accepted by the antenna*, and *returned* back to the transmitter. The *returned power* is called *standing waves*, the analogy being that "waves" (or power) not accepted by the antenna and radiated into the atmosphere "stand" upon the transmission line. Of course *they do not stand* any place; they are moving with the speed of light (less the slowdown factor of the dielectric constant of the cable), and they in fact end up primarily *back in the transmitter* power amplifier, where they cause additional heating of the amplifier stage.

The practice of measuring the amount of power returned by the "load" on a transmitter has developed into something called *VSWR measurements;* or measurement really of the efficiency of the transmission line/antenna system in communication systems. This is often expressed as a percentage, and we have similarly adopted the practice in CATV by referring to match (i.e. impedance match between two separate component parts) as so many dB. We commonly note that this or that box has a *20 dB match*, which is simply another way of saying that according to VSWR measurement criteria, the amount of power *reflected or returned* from the "load" at the end of our transmission line (or the input or output port of the device we are measuring) is 20 dB lower (i.e. less) than the level of power which is sent into the device or line. In real life, a 20 dB match is the same thing to us as a VSWR of 1.22 is to a communications person. Both mean the same thing.



RETURN LOSS, VSWR

DIAGRAM 4

Both also mean that in terms of power initiated, 4.4% of that power is reflected away (i.e. not accepted) by the device which has a 20 dB match/VSWR of 1.22. *These are not magic numbers* that require extensive match background to calculate or formulate; charts abound which spell out all of this and more, and if you know (for example) that the match is 20 dB, the charts quickly allow you to determine what the equivalent VSWR is and the equivalent percentage of power not accepted by the load or line.

Match or impedance matching between two separate devices or components is one of the important factors that all CATV people must learn to contend with. In a nutshell, the "better the match" the more efficient the transfer of input power going into a device (any device, including transmission cable) and therefore the more input power that actually goes *into* the device. Every CATV component has match (input and output) criteria. A pre-amplifier on the tower with a 10 dB input match will lose (i.e. not even admit) approximately 30% of the antenna-delivered *signal voltage* to the input of the pre-amp, for example. Another device, with a 30 dB "match," will effectively lose just over 3% of the delivered *signal voltage* at the input to the device.

Obviously, we are *not* anxious to give away *valuable power* (signal voltage) *any place* in a CATV system. And every conductor, every splice, every input and output port, even every foot of cable, if it has a "poor match," gives away power (signal voltage).

There is one more reason to be concerned about match: that is the previously referenced "standing waves." Again, the waves don't stand any place, they move about very rapidly. But along a specific length of cable (where waves are said to "stand") they appear to *stand still.* That is, *they have voltage and current maximums and minimums* along a specific piece of cable (the amplitude of these voltage and current peaks and nulls is directly related to the VSWR); simply because the standing waves *appear* to always be current or voltage peaking *at the same point along the specific* (unchanging) *length of cable.* These "standing waves" are signal components that did *not* make it into the normal forward flow of signal. In effect, they are *out* of the "mainstream" of travel, because some device (connector, etc.) has said, "No, 3% of you guys have to stay out of my connector innards (match of 30 dB referenced)." Now when you plug this line, with a standing wave on it, *into something like a television receiver,* the receiver *sees* not only the forward-flowing wave (the 97% of the power that is accepted), *it also sees* (weakly, or less strong than the 97% forward-flow signal) *the standing waves.* These "delayed-in-time" signals, as displayed on the television receiver, show up as slight ringing (or ghosts) on the picture tube.

So not only are we concerned with match and standing waves because precious power can be lost (power lost translates into decreased amplifier spacings, which translates into more bucks per mile of CATV plant), we are concerned because our customers look at their $800 color receiver connected to our cable and say, "What are those funny, faint lines outlining the man's face just to the right of his face?" And that translates into unhappy customers, which translates into bucks lost.

All of which leads up to the need for at least one system-available method for checking component match. The 260-A will let you do this, with the assistance of the omnipresent SLM/FSM. See Diagram 4.

In use, the 260-A uses the SLM/FSM to read forward-going power (as a reference), and using something called a bridge (the device that detects returned power present in the form of standing waves) the SLM/FSM then measures the returned power. If you start out with a 0 dBmV reference signal (wideband noise from the 260-A) and find that in the *returned*-power measurement mode you have —20 dBmV level present, you match is 0 minus 20 or 20 dB. That is all there is to it! If you want to change this to percentage of transmission loss or VSWR, a handy chart with the 260-A does it for you. The process is quick and simple and can be applied to any active device (to check input or output port match), any DT (to check input, output ports or tap ports), any passive device such as a splitter, bandpass filters (you may discover something here!), or a roll of cable.

By using the wideband noise source (flat from 50-300 as noted) to check a roll of cable you can *measure the cable's actual loss*, tilted as it will be, from 50-300 MHz, and then turn the process around with one simple connection change on the 260-A and *measure the match of the roll of cable*. To do both on a roll of cable where you have access to both ends of the cable should take you about two minutes longer than it takes to put the connectors on. That is a fair investment for spotting cable problems *before* you have spent hours installing that roll!

Opens and Shorts

An open line (no termination) or a shorted line (crushed cable, etc.) would, as you might suspect, have those nasty standing waves sitting around, if RF power is applied into one end. After all, with an open or short, the line is not terminated in 75 ohms any longer, and when the inward-bound signal runs into that non-75-ohm termination (or open), it is going to *reject* some portion of the inward-bound signal and set up standing waves.

The 260-A, again with the able assist of an SLM/FSM, can help you locate the area along the cable where the open or short is located. To verify that you have a short or open, simply follow the outline for checking on match (see Diagram 4). Once verified, you can use the 260-A to pin down where along the line the short or open should be, with pretty decent accuracy, in about 500 feet of cable. This means that you can actually handle 1,000 complete feet of cable in a single span by going at it from *both ends*.

The principle is this. If there is a short or open, there are standing waves. Standing waves are frequency coherent; that is, they set up or stand up (if you will) at precise points along the cable medium based upon the distance between the transmitter source (the 260-A) and the short or open. This "precise distance between standing wave peaks" (voltage peaks) is always a function of the distance between source and fault. And you can read these peak-and-valley voltages by tuning an SLM/FSM through a relatively narrow range (usually within a TV channel span or two) and note on your SLM/FSM the frequency on the dial where these voltage peaks appear. *The MHz difference between peaks tells you something:* it tells you the distance to the short or open, if you happen to know the dielectric constant of the ca-

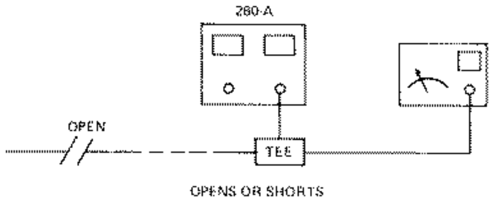


DIAGRAM 5

ble. The 260-A gives you a chart for this that tells you, for example, that if you find you have 10 MHz between voltage peaks as tuned on your SLM/FSM, that the short or open is 31 feet away from you in polyethelene foam cable. If you happen to have a splice down the line 31 feet, you know *where to start* your search for trouble!

This is done with the 260-A, an SLM/FSM, and simple-to-read chart or graphs. It is, in a sense, a poor man's TDR.

Noise Figure

Most people think measuring noise figures is a back-room black art. The fact is that with a wideband noise source such as the 260-A, an SLM/FSM and reasonable intelligence you can not only measure (and spec) any broadband or narrow-band (i.e. single-channel) amplifier noise figure with respectable accuracy, you can do it with repetition and have correlative results.

Why bother, you ask. Let's take single-channel pre-amplifiers. They sit up there 200-600 feet above ground and perk away for years. But you have the gnawing feeling that the signal-to-noise ratio "looked better" two years ago when you put the unit into the air. Maybe some moisture has gotten into the unit; perhaps a series of lightning strikes on your tower has slowly cremated the input F fitting on the unit and it simply no longer has a decent match (which means antenna energy is being rejected, which means signal-to-noise has suffered). You could take the unit down and replace it with a new one. You could take it down and look for cremated parts, signs of moisture, and what have you. Or you could take it down and check the gain, response curve, and noise figure (*all* with the 260-A and an SLM/FSM).

In the noise figure game there are numbers, and then there are *numbers*. Any supplier that produces noise-figure-sensitive units (i.e. pre-amps, processors, etc.) has a spec on his data sheet (or even imprinted on the unit itself, such as many pre-amps now do). The chances of your taking your 260-A and SLM/FSM and measuring the noise figure of your unit (even if brand new right out of the box) and *matching the imprinted on the unit-noise-figure* from the supplier are slim at best. You may measure higher, or you may measure lower. But you will *seldom*, if ever, *measure the same*.

This is not to say that the supplier has cribbed on you. His noise-figure test setup is probably considerably different (read elaborate) than your 260-A and SLM/FSM. He measures precise noise figures, *on his test setup*, all day long five or six days a week. His numbers *are his numbers*, and while they may (or may not) have some traceability to real-world noise figures, they are in truth *relative more than precise*.

So too will yours be with the 260-A. If you start out with a *new* pre-amp (or processor) and measure noise figure before installing the unit, *record* the measurement you make for later reference, and then check back on the unit one, two, or three years hence to see how it is doing; *then your original number means something*, provided you are still using the 260-A and the *same* SLM/FSM for the subsequent check.

Or you can reference the unit you pulled off of the tower against another identical, spare (not necessarily same channel, but it should be the same band such as low or high) type of unit. If the tower unit is considerably higher in indicated noise figure than the spare, suspect that you do have a problem.

Summary

The 260-A does so many things that it is hard to find fault with it. Rather, it is our studied view that *if there is fault to be found*, it is with an industry that runs around crying and screaming about plant problems or supplier-defective equipment which could be spotted and corrected quickly and accurately for not very many test-equipment bucks, with the 260-A.

If there is fault to be found with Sadelco for the 260-A, it is the manual. The manual is *almost too comprehensive* for the average CATV system operator. The instrument itself *is easy to operate and simple to understand.* The manual makes long, lengthy cases for the use of higher-math equations for simple things like locating where a short or open is, or how to measure noise figure. The material presented is close to flawless, *but the approach is scary* because the average CATV type who takes the time to look at the manual *before* buying the instrument will, we feel, come away shaking his head and muttering that he never got beyond tenth-grade algebra (and most of that he has forgotten!).

You don't need any math to operate the 260-A. The manual, while being exhaustive to the point of losing everyone but Archer Taylor or Sruki Switzer, ends up most of the explanations with a table or chart that *anyone* who can draw a straight line with the aid of a ruler can comprehend and use.

In short, *don't be scared away by the Sadelco passion for long, detailed, highly mathematical explanations.* On a pole, in a ditch or even on the tower with you and your trusted SLM/FSM, the 260-A will provide instant and significant measurement results for even the novice.

Sadelco 260-A Specifications

Wideband Generator
- A) White noise
- B) 4.5-300 MHz
- C) Min output +10 dBmV
- D) Flatness +/— 0.25 dB

Narrow-Band Generator
- A) 73.5 MHz crystal
- B) Output level 1 mV
- C) Accuracy +/— 0.25 dB
- D) 75 ohms, VSWR 1:1
- E) Harmonic levels, —35 dB

Return Loss Bridge
- A) 75 ohms impedance
- B) Balance —40 dB min
- C) Unterminated ref level —1 mV
- D) Flatness +/— 2 dB
- E) Open/short ratio 1 dB or better

Attenuator
- A) 1 each 1, 3, 6, 10 dB
- B) continuous +/— 1 dB

Operating Temp
- A) +60/+85 degrees F, negligible variation
- B) +32/+100 degrees F, +/— 0.5 dB variation

Battery
- A) 13 Eveready CH500T or equal
- B) 6 hours on charge, wideband
- C) 36 hours on charge, narrow band
- D) 10 hours charging time

Physical
- A) 4-3/8 x 8½ x 11 inches
- B) 9 pounds with case
- C) Price — $595.00
- D) Manufacturer:
  Sadelco, Inc.
  299 Park Ave.,
  Weehawken, N.J. 07087
  (201/866-0912)

COMPUTER TECHNOLOGY AIDS RATE INCREASE PRESENTATIONS

"Mr. Mayor, members of the city council, ladies and gentlemen. My name is John Turner, and as you know, I'm the Manager of the cable system. We need a rate increase. We've been charging our customers the same rate for seven years and just plain can't live on $4.95 a month. We were thinking about raising the rate to $5.95 a month and increasing the installation fee from $15 to $25. I hope to put the new rates into effect June 1st and will answer any questions you may have."

At that point he was interrupted by shouts from the audience. It seemed that everyone there knew more about the financial status of cable than the system manager. The *Citizens Lobby for Public Access* wanted a television studio with color capability and staff made available. The *League Against Violence* wanted fewer murders and more football. The *Decency in Media* group wanted less sex and more soap operas. They all wanted the rates reduced and a new franchise hearing, with competitive bids and minority participation.

This is a scene many of us will face over the next few years. It's not pleasant, but it can be productive.

by:
James A. Richardson
PLANTATION CABLE/RESEARCH
℅ Plantation Cablevision, Inc.
One Park Drive
Hilton Head Island, SC. 29928

Today nearly every cable system in the country is faced with a lack of funds. There are as many causes as there are systems, but some of the major contributions are inflation, increased technical requirements, soaring interest rates and the increases in labor expense with the cost of living. Rates which were fine in 1967 simply won't pay the bills today.

Asking for a rate increase is a last resort. First, a system owner or manager must make sure that he is making the best use of every dollar he has and that he explores every option available. This takes time and effort, and in many cases an accountant's knowledge.

Up until now I've made all too many decisions on a "gut feeling" or "experience." This wasn't by choice; it simply took too much time to prepare a complete projection. I think I was right more often than not, but then I'm lucky.

One way to get the information that you need is to make a complete financial projection for each option. This can be done quickly and easily by letting a computer handle most of the time-consuming, tedious jobs. The system manager is then free to explore which option should be followed, and to make decisions based on the best projection.

Basically, there are only two ways profitability can be improved. You can reduce expenses or you can increase revenue. That sounds simple, something everyone knows, but how you do that is a little more difficult.

Running a cable television system is much like trying to maintain an ecological balance. You can't make changes in a vacuum. Everything you do must be related to its middle- and long-term effect.

First, consider how a computer might be used to help reduce expenses. In most systems the largest single item is debt service. Debt service itself depends on just about every action you can take. In addition to the obvious one, revenue available, there are other important but subtle factors.

Of major importance is how much plant you build, and when you build it. By rescheduling construction, it is often possible to improve the overall picture. Rescheduling is not without hazards however. You will lose the revenue from whatever subscriber you would have hooked up in the delayed area. You will also increase the cost of the plant by whatever effect inflation has on the cost of labor and materials. Changing the amount of plant you build in a given period will also affect your operating expenses, the number of techs and installers required, taxes, and insurance and franchise fees.

By hand, this would be a major job. With a computer you simply change two input lines, miles of plant built per year, and additional homes passed. The machine will then handle all the calculations; you look at the results and pick the most promising.

Another major factor in debt servicing is the loan itself. Over the past year, interest has increased over six percent. Now it is beginning to decline. Simply refinancing a loan might help. For those of you who have a loan based on prime rates, it is essential that you know what effect changes in the prime rate have on your system's cash-flow position.

If your system was financed at a higher interest rate it might be profitable to explore refinancing. If interest has come down, you could save thousands of dollars. A drop of only one percent on a $150,000 note would mean $1,500 a year to your system. If your loan is larger or if you can refinance at more than a percent less than you are paying now, you could save even more. The computer lets you find the overall effect on your system quickly and painlessly.

Computers? Good Grief!

Author Richardson proposes that CATV systems and systems-to-be equip themselves with sufficient facts and figures to be able to make a coherent presentation to (1) city councils, (2) lending institutions, when the need arises. One way to have the data available is to laboriously compute it all by hand.

Richardson, mindful of the growing use of computer technology in all phases of business, urges system operators to consider how much quicker, nicer, and more accurate computer-comparison studies can be. He doesn't indicate at what system size such approaches become too expensive for consideration, but he assures **CATJ** that the program he has written has been extensively used in the development of the Plantation Cablevision system at Hilton Head Island (1150 subs at present). The program itself is written and available, and we review its functions separately here.

As expenses increase and sources of money become scarcer, new forms of funding must be explored. Leasing is one of them.

Leases come in many types. Before anyone decides to lease a system, he should thoroughly explore the effects on his system. Who takes depreciation? Is there a set purchase price for the system at the end of the lease? What about maintenance and replacement of plant? Who pays taxes and insurance? All of these factors may be simulated with a financial planner. You can compare a lease, lease-purchase, or conventional financing package before you decide.

So far we have only talked about debt service as a way to reduce expenses. There are other factors which should be investigated. Fortunately, a computer model lets you try ideas quickly. Are there any items which would significantly affect your profit-and-loss position? How large an inventory are you maintaining? Often people are amazed when they stop and add up the dollars in their storeroom and on their trucks. How about your overhead? Are there any places where you can cut costs without harming service? A computer can't give you the answers, but it can certainly help you gather the information to make a choice.

The other way to improve your financial position is to increase your revenues. You can do that by increasing your number of subscribers, or by increasing your rates.

You can increase your subscribers by selling more people or by building more plant. The first choice is usually the best but the most difficult. The second approach, building more plant, is easier but requires that you have additional plant to build and that a large chunk of money be spent at the front end.

To find out which method would work best, you try them on the computer. If you are attempting to increase penetration in your existing plant, you must consider several things. You will have to try harder to make each sale. Most of the people left to sell have already decided not subscribe. You will have to change their minds. This might take the form of incentives such as free installations, free service, or some form of premium. You may have to increase your advertising budget to attract new customers. At the least, you will have to knock on more doors before you get a sale. These costs will have to be considered. Fortunately the

SCHEDULE 1

CUSTOMER PROJECTION

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
HOMES IN FRANCHISED AREA	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000
APARTMENTS IN FRANCHISED AREA	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000
ANNUAL MILES OF PLANT	240	40	40	40	40	40	0	0	0	0
TOTAL MILES	240	280	320	360	400	440	440	440	440	440
HOMES PASSED	11600	13600	15600	17600	19600	21600	21600	21600	21600	21600
APARTMENTS PASSED	4350	5250	6150	7050	7950	8850	8850	8850	8850	8850
SYSTEM SATURATION-HOMES	44	49	53	56	59	60	62	63	64	64
SYSTEM SATURATION-APARTMENTS	60	68	72	75	78	81	84	86	88	89
PROJECTED CUSTOMERS-HOMES	5219	6699	8279	9959	11738	13037	13437	13736	13935	14034
PROJECTED CUSTOMERS-APARTMENTS	2610	3584	4431	5324	6261	7243	7512	7692	7826	7915
TOTAL CUSTOMERS	7829	10283	12710	15283	17999	20280	20949	21428	21761	21949

The CABLEVISION FINANCIAL PLANNER is a computerized financial model designed to provide the system operator with vital information you need, along with options where required. The complete financial plan for any given system is approximately a dozen pages long, and it covers all aspects of the system's growth, financial requirements, cash flow and rate requirements. Although the sample page from the example system shown here is for a fairly extensive system (23,000 potential homes), the system is cash-cost viable for very small system potentials down to as few as 500 homes.

computer program is set up to handle such problems. Two of the normal entries are *percent-free-installations* and the cost to add a new subscriber.

Building new plant is also easy to calculate. Once you enter the cost per mile, miles of plant to be built, and the number of homes passed, the computer does the rest. It will calculate the number of subscribers you should get, the revenue created, any additional expenses required such as more installers, tech or office help, increased loans or payments and all the other things that will affect your financial picture. The result is two tables: one showing your profit-and-loss position, the other showing cash flow.

The other major way to increase revenues is to raise your rates. That, at least, is obvious, but how do you determine how much is enough, or which rates to increase? Well, you could sit down and work out a complete budget, but if you have ever made one projection—much less several variations on a theme—you know how much work that involved.

Much of what you need is already in the program. It was designed to increase rates to offset inflation. If you tell the machine to increase your rates every four years, or whatever period you think will be reasonable, it will automatically calculate the effect of inflation on labor and materials, and then raise your rates to compensate. If you wish to raise only certain rates, say primary rates and advertising revenue, you just input the new rates. Then you either increase or decrease the rates until you find the optimum rate schedule. Using the computer, you can try several variables in less time than it would take you to prepare one projection by hand.

So far we have only talked about using a computerized financial program to help an owner or manager in an existing system make his day-to-

SCHEDULE 3

REVENUE ASSUMPTIONS

	1	2	3	4	5	6	7	8	9	10
MONTHLY RATE-PRI. OUTLET-HOMES	5.95	5.95	5.95	7.10	7.10	7.10	10.10	10.10	10.10	17.10
MONTHLY RATE-PRI. OUTLET-APTS.	1.50	1.50	1.50	1.80	1.80	1.80	2.60	2.60	2.60	4.40
MONTHLY RATE-SEC. OUTLET-HOMES	1.00	1.00	1.00	1.20	1.20	1.20	1.75	1.75	1.75	3.00
MONTHLY RATE-SEC. OUTLET-APTS.	1.50	1.50	1.50	1.80	1.80	1.80	2.60	2.60	2.60	4.40
CONNECTION FEE-PRIMARY-HOMES	10.00	10.00	10.00	11.95	11.95	11.95	17.00	17.00	17.00	28.75
CONNECTION FEE-PRIMARY-APTS.	10.00	10.00	10.00	11.95	11.95	11.95	17.00	17.00	17.00	28.75
% FREE INSTALLATION-PRIMARY	0	0	0	0	0	0	0	0	0	0
CONNECTION FEE-SECONDARY HOMES	5.00	5.00	5.00	6.00	6.00	6.00	8.55	8.55	8.55	14.45
CONNECTION FEE-SECONDARY-APTS.	5.00	5.00	5.00	6.00	6.00	6.00	8.55	8.55	8.55	14.45
% FREE INSTALLATION-SECONDARY	0	0	0	0	0	0	0	0	0	0
MONTHLY RATE-PAY TV	6.00	6.00	6.00	7.15	7.15	7.15	10.15	10.15	10.15	17.15
PAY TV DEPOSIT REQUIRED	35.00	35.00	35.00	41.70	41.70	41.70	59.20	59.20	59.20	100.05
PENETRATION GROWTH-HOMES	0.45	0.50	0.55	0.60	0.65	0.65	0.65	0.65	0.65	0.65
PENETRATION GROWTH-APTS.	0.60	0.70	0.75	0.80	0.85	0.90	0.90	0.90	0.90	0.90

The primary advantage to the computerized technique is not the slick appearing computer print-out of the numbers, but the immediate flexibility which the system operator has in analyzing changes in the input numbers. For example, if the system study is built upon a $5.95 rate initially, what happens if the rate is increased to $7.10 in the fourth year? The answer is laborious to calculate, and very time consuming. With the assistance of a computer, it is almost instantaneous and the computer run time is usually far outweighed, as a cost factor, by the immediate answers and the accuracy of the answers.

day decisions. What about a new system?

Any new system faces unique problems. The first and most important project is to develop a complete plan of exactly what you want to do. More than at any other time it is essential to play "WHAT IF." What if plant costs go up? What if our penetration growth is a few percentage points better? Or worse? What rates will we need? What type of equipment can we afford? Should we add local origination at first or wait until we have built up a subscriber base? What effect will inflation have? What type of loans can we handle? How much capitalization will be required?

All of these questions must be answered even *before* you *apply* for a franchise. If you already have a franchise, you must live within it, but you *still* have options available.

Sooner or later you'll reach the point where you have to sit down before the people with the money and show them how you expect to make a profit. If you can show them a complete proforma which considers all facets of building and operating a system, they will be more likely to *listen* to your proposal. If you can also show them that you have considered alternatives such as various financing packages or what effect changes in saturation, inflation, or varying interest rates would have on your system, they will be even more likely to fund your project.

When planning a system you should start as early as possible. Often a franchise is offered on a "bid" basis. Generally the city issues guidelines outlining what they want and sometimes even specifying rates. Usually the rates are simply a number pulled out of the air or used because "everyone else gets $4.95." If you develop your proposal and find that the system simply can't be a financial success at those rates, you are faced with three choices. First, you can agree to the conditions, try to live with the rates, and lose money. Your second choice is to agree to the conditions, build your system, and then fail to live up to your obligations. This has been tried in the past, but now cities are starting to get a *little* huffy. They expect us to start delivering some of that blue sky we promised.

The third option is to try to convince the franchising authority that either they are asking too much or the rates are too low. This is a difficult thing to do, and you risk losing the franchise to someone who promises the world, but it's the best approach. All the data you can get is just not enough though. Here particularly, a computerized proforma is a necessity. If you can show the franchising authority in black and white what the problems are and what solutions are possible, they will know two things about you. First, that you plan to make a success of the system in their town, and second, that you have seriously considered what is required to bring the best cable service to them.

Once you have decided on your supplier and have located funding, you are ready to build. As your system grows, you will find even more uses for a computerized proforma. By regularly updating the data input to the computer and recalculating your projections, it is possible to keep track of exactly where you stand. You can spot trends developing before they become problems, and take advantage of changes.

Today a system manager must be part politician, part engineer, part father figure, and above all, accountant. To make a system succeed, every dollar must go as far as possible. To do that, the manager needs all the information he can get. By using a computerized financial planner, even the smallest system can afford to explore the options available. Now, the time that was spent trying to put together budgets and projections can be spent making the decisions needed to make the system more profitable.

WHAT A FEW PEOPLE HAVE SAID ABOUT THE MARCH/ APRIL ISSUES OF CATJ

Editor's Note: CATJ received several hundred letters from broadcasters, educators, journalists, Congressmen, CATV people, etc. following the March and April issues of CATJ. Most were purely laudatory, and while we do appreciate the nice comments, we see no useful purpose in filling valuable CATJ page space with letter after letter after letter of congratulations. We did not acknowledge each one individually, so allow us to do so here with a "thank you for your kind comments" **to all who wrote.**

We will share a few of the letters received, here, however, where they are of an informational nature.

Editor:

Your March 1975 issue, with the in-depth study of the background of TV allocations, gladdens my heart. For on Page 42 I found in print for the first time acknowledgement of a TV/Radio first which I instigated and saw through successfully. This program was, I believe, the salvation of many small market UHF stations.

I was General Manager for Donrey Media Group, operators of KFSA AM/FM and CP holder for UHF channel 22 in Fort Smith, Arkansas. Our problem was getting network program delivery from AT&T. We wrote to the telephone company in St. Louis time and time and time again asking for relief. They never answered a single letter. They always sent a man down to talk with us, so there would be "no permanent record of his telling us 'no' on the matter of microwave relief".

So I requested of the corporation president, and received his permission, to install a 0.1 watt Raytheon microwave unit on our own midway between Little Rock (where netowrk service was available) and Fort Smith, on top of a 3,000 foot mountain. On the mountain top we picked off the Little Rock network signal from a Little Rock station, and then beamed it on to Ft. Smith 47 miles. The grant for the "experiment" came through just in time for the World Series. Our demodulator was an ordinary television receiver and we went into it to bring audio and video out for the microwave transmitter.

I am on the cable side now, after 40 years as a broadcaster. I've copied a lot of good ideas other people have originated. But I just wanted someone to know this one originated with me, and I am proud of where it led.

H. Weldon Stamps
President
Jekyll Cable, Inc.
Jekyll Island, GE.

Editor:

Some confusion for me on "CBS being an offshoot of RCA". This may be true, way, way back. But I seem to recall that either the red or blue network became ABC (radio): not CBS. Am I wrong? Incidentally, that was a great, great job on the FCC "confusion" through the years. I wish every subscriber, government official (local) and Congressman could read your March/April issues.

Jack Sandstrom
Fayette TV Cable, Inc.
Uniontown, PA.

Reader Sandstrom is correct; ABC (not CBS) **was the creation of the radio network splitting of the early NBC multiple radio networks.**

Editor:

Having just read your April 1975 issue of CATJ, I find it difficult to comprehend your logic; logic dealing with degradation of television broadcasting, networks, et al. My question is: Where would Cable TV be today without television broadcasting? Actually, where would you and **CATJ** be without television broadcasting and Cable TV?

Sheldon F. Storrier
Secretary-Treasurer
WKTV Channel Two,
Central New York Cable TV, Inc.
Utica, New York

The same place you would be; listening to the red or blue radio networks on our Atwater-Kent living room console. Arguendo, where would Hitler be without World War Two?

Editor:

Until the April issue of **CATJ** arrived, I had no idea that the television stations owned by the three major networks had succeeded in obtaining such an exorbitant profit level. Quite frankly, it does appear that the FCC has been overzealous in the issuance of unwarranted and unjustified regulations.

Senator Henry Bellmon
Washington, D.C.

Editor:

I believe the cable television industry is currently overregulated by the Federal Communications Commission. In order to alleviate this problem, I have instructed my staff to undertake a study of cable television and its needs. We will investigate existing Commission rules governing the industry to determine which measures are in the best interest of both cable systems and the public which they serve. In addition, we will look at whether cable should be regulated on the federal, state or local levels, and whether this regulation has impaired the growth and development of CATV. Hopefully, the recommendations of the Subcommittee will lead to the introduction of legislation that will directly address the problems to which **CATJ** refers.

Torbert H. MacDonald, M.C.
Chairman, Subcommittee on
Communications

Editor's Note: CATJ/CATA received more than 130 similar letters from Senators and Congressmen following the March and April issues of CATJ.

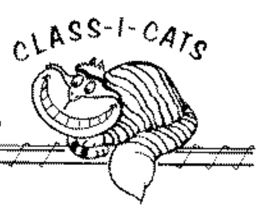
Editor:

I would like to protest the cover of the April '75 CATJ, using a quote from the Bible in a joking manner. Certainly your people have better resources for use in the Journal than offending Christians with such abuse of God's word.

Roderick Luoma
WJBK-TV
Detroit, Michigan

Protest acknowledged. Respectfully, the quotation was not intended as a joke. Nothing could be more serious than the survival of CATV to 10,000,000 U.S. cable-served households. As for a better **resource . . . than the Bible?**

CLASSIFIED ADS



CLASS-I-CAT RATES: Classified advertising space is available at 8 cents per letter or space between words. Type or print insertion required, add the total number of letters and spaces between words and multiply by 8 cents. Enclose full payment with advertisement. The deadline is the 20th of the month preceding the publication in which you wish your ad to appear. CATJ box numbers (for the forwarding of replies) are available at $5.00 per issue. Send insertions to CATJ CLASS-I-CATS, 4209 NW 23rd Street, Suite 106, Oklahoma City, Ok. 73107.

HELP WANTED—Manager/Chief Technician wanted to run small CATV system (under 1,000 connects) in southeastern USA. Must be mature, responsible, self starting individual. Send complete data in confidence, including resume and salary requirements, to Box J1, % CATJ, 4209 NW 23rd, Suite 106, Oklahoma City, Oklahoma 73107.

cata ASSOCIATE MEMBER ROSTER

In recognition of the untiring support given to the nation's CATV operators, and their never-ending quest for advancement of the CATV art, the COMMUNITY ANTENNA TELEVISION ASSOCIATION recognizes with gratitude the efforts of the following equipment and service suppliers to the cable television industry, who have been accorded ASSOCIATE MEMBER STATUS in CATA, INC. for 1975.

Anixter-Pruzan, Inc., 1963 First Ave. S., Seattle, WA. 98134 (**D1**)
Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA. 95051 (**M8**)
Belden Corp., Electronic Division, Box 1327, Richmond, IN 47374 (**M3**)
BROADBAND ENGINEERING, INC., 850 Old Dixie Highway, Lake Park, FL. 33403 (**D9, replacement parts**)
Burnup & Sims, Box 2431, W. Palm Beach, FL. 33401 (**S2, S7, S8**)
Cable Dynamics, Inc., 501 Forbes Blvd., So. San Francisco, CA 94080
CABLE NEWS, 2828 N. 36th Street, Phoenix, AZ. 85008 (**S6**)
Cerro Communication Products, Halls Mill Road, Freehold, NJ 07729 (**M3, M5, M7**)
COMM/SCOPE COMPANY, P.O. Box 2406, Hickory, NC. 28601 (**M3**)
Jerry Conn & Associates, 550 Cleveland Ave., Chambersburg, PA. 17201 (**D3, D5, D6, D7**)
C-COR ELECTRONICS, Inc., 60 Decibel Rd., State College, PA 16801 (**M1**)
DAVCO, Inc., P.O. Box 861, Batesville, AR. 72501 (**D1, S1, S2, S8**)
DEVINES Trailers & Accessories, Grantville, PA. 17028 (**M9, cable trailers**)
ENTRON, Inc., 70-31 84th Street, Glendale, NY. 11227 (**M4, M5, D4, D5, S8**)
GAMCO INDUSTRIES, INC., 317 Cox St., Roselle, NJ. 07203 (**M5**)
JERROLD Electronics Corp., 200 Witmer Road, Horsham, PA. 19044 (**M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8**)
Kay Elemetrics Corp., 12 Maple Avenue, Pine Brook, NJ. 07058 (**M8**)
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, NY. 13057 (**M5, bandpass filters**)
MID STATE Communications, Inc., P.O. Box 203, Beech Grove, IN. 46107 (**M8**)
Pro-Com Electronics, P.O. Box 427, Paughkeepsie, NY. 12601
OE Manufacturing Co., Box 227, New Berlin, PA., 17855 (**M9, tools & equipment**)
RMS CATV Division, 50 Antin Place, Bronx, NY. 10462 (**M5, M7**)
TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN. 46219 (**M8, bandpass filters**)
Theta-Com, P.O. Box 9728, Phoenix, AZ 85068 (**M1, M4, M5, M7, M8, S1, S2, S3, S8, AML Microwave**)
Times Wire & Cable Co., 358 Hall Avenue, Wallingford, CT. 06492 (**M3**)
TONER Equipment Co., 418 Caredean Drive, Horsham, PA. 19044 (**D2, D3, D4, D5, D6, D7**)
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN. 46107 (**M8**)

NOTE: Supplier areas are keyed at the end of each listing, as follows

Distributors:	**Manufacturers:**	**Service Firms:**
D1—Full CATV equipment line	M1—Full CATV equipment line	S1—CATV contracting
D2—CATV antennas	M2—CATV antennas	S2—CATV construction
D3—CATV cable	M3—CATV cable	S3—CATV financing
D4—CATV amplifiers	M4—CATV amplifiers	S4—CATV software
D5—CATV passives	M5—CATV passives	S5—CATV billing services
D6—CATV hardware	M6—CATV hardware	S6—CATV publishing
D7—CATV connectors	M7—CATV connectors	S7—CATV drop installation
D8—CATV test equipment	M8—CATV test equipment	S8—CATV engineering

NEW RMS UNITAP — RMS Electronics, Inc., 50 Antin Place, Bronx, New York 10462 has introduced a new inline multi-tap called Unitap. The new tap unit has "13 new engineering concepts for inline multi-tap design units" according to Kerwin McMahon, General Sales Manager. The units are available for strand or pedestal mounting with interchangeable tap plates.

According to RMS "initial customer acceptance of the new tap has been so brisk that orders for the new unit can only be accepted for a 90 day guaranteed delivery basis, initially". Full information on the new tap is available from RMS.

JERROLD IS BUSY — Jerrold Electronics Corporation, 200 Witmer Road, Horsham, Pa. 19044 has announced a number of changes in business policies recently, which directly affect Jerrold customers world wide.

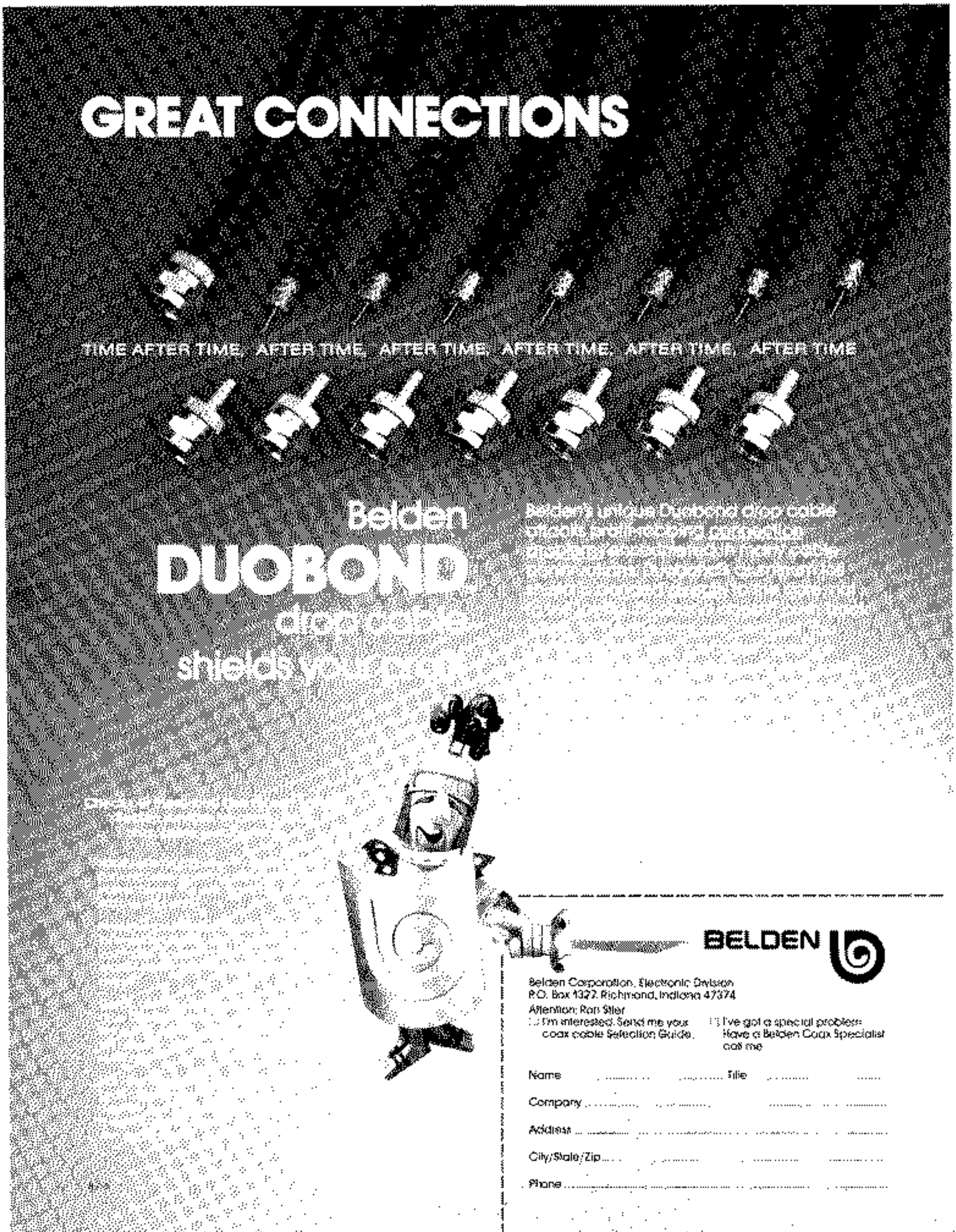
To provide faster, improved parts and repair services, Jerrold has expanded its Parts and Repair Departments; and CONSOLIDATED these departments at Kansas City, Missouri.

According to Raymond Pastle, Jerrold's National Sales Manager, the national headquarters for repair and parts is now located at (JERROLD ELECTRONICS CORPORATION/FACTORY PARTS AND SERVICE FACILITY), 1322 ATLANTIC AVENUE, NORTH KANSAS CITY, MISSOURI 64116. Manager of the expanded facility is Hap Wampler and the telephone number is (816) 842-1130. The expanded Kansas City repair facility/parts facility replaces two other locations for parts and service located in Redwood City (California) and Chicopee (Massachusetts). The Redwood City facility continues to handle west coast sales.

Jerrold's William Lambert, vice president and division manager of Jerrold's CATV Systems Division, has announced a new "design service for new systems, system rebuilds and system extensions for Bill-of-Material (distribution) systems". Under the new program, Jerrold will continue to design Starline 20 and Starline 30 distribution systems on a no-charge basis. As a BOM system is constructed, any changes in equipment location or cable routing is noted on the drawings supplied by Jerrold, by the construction personnel. Then, after construction is finished, if the system wishes to have the construction drawings with changes incorporated-during-construction finalized into a set of "as-built" maps, the maps can be returned to Jerrold in Horsham for re-drawing. A fee of $35.00 per mile for re-drawing will be charged, and for an extra $1.00 per mile, 11 x 17 inch reproducibles can be supplied in booklet form.

Full information on the new program is available from William Lambert at Jerrold's Horsham office.

Jerrold's Robert D. Eisenhardt, Jr., president of Jerrold Electronics, Inc. has announced that his firm is introducing a Channel Commander "E", a special headend processor tailored to the (largely) European CCIR standards. The new "E" version Commander is similar to the new Channel Commander III unit recently shown in the United States and Canada. The "E" headend unit follows on the heels of the introduction in Europe of the Starcom—33 converter; which has also been engineered to CCIR standards. Jerrold sales and other European matters are handled by JERROLD INTERNATIONAL, 70 CHAUSEE DE CHARLEROI 1060 BRUSSELS, BELGIUM.



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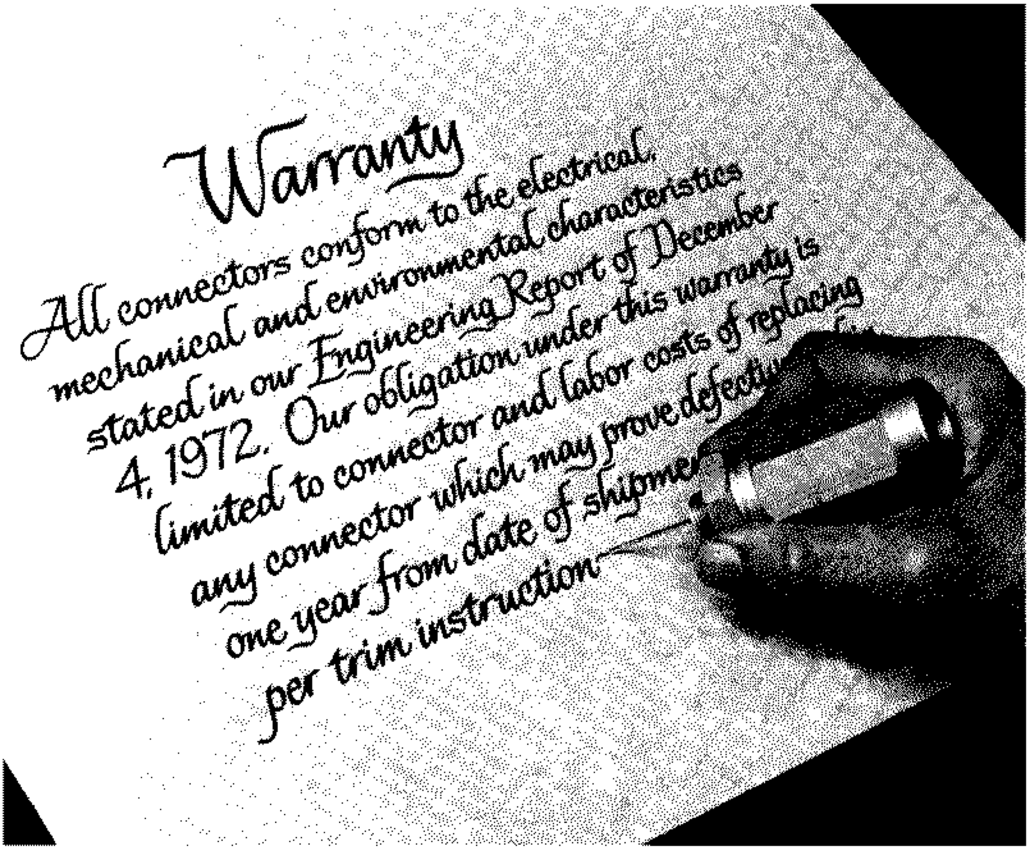

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