THE JOURNAL OF THE SOCIETY OF BROADCAST ENGINEERS

VOLUME ONE , NUMBER TWO OCTOBER 1964

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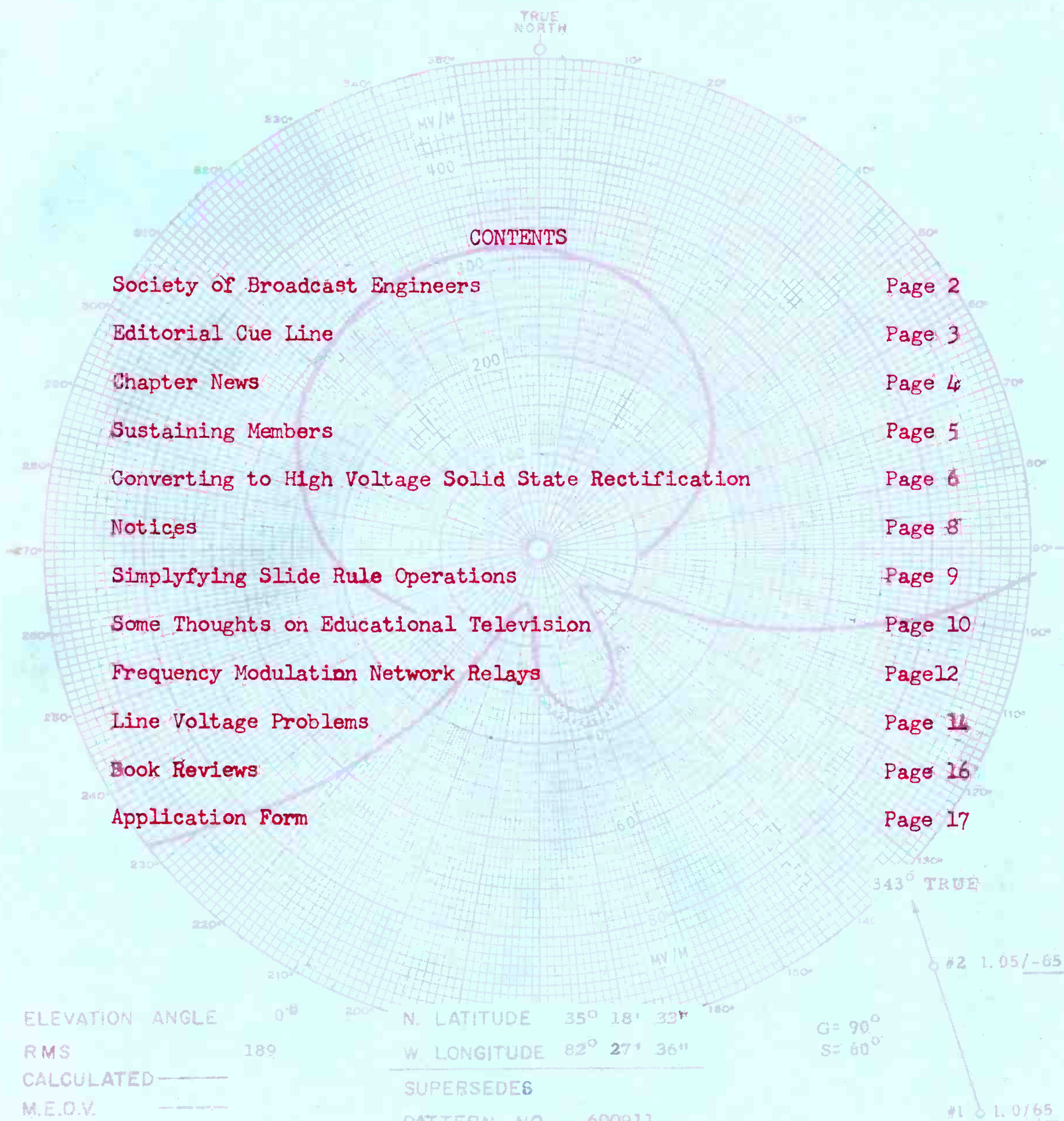

THE

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THE SOCIETY OF BROADCAST ENGINEERS -

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EDITORIAL

CUE LINE

ONE DOWN, MORE TO GO!

With this, the second issue of the JOURNAL of the SBE we can all look quite proudly on what we have achieved. This time last year, the Society of Broadcast Engineers was only an idea, mainly in the heads of a very few people. Today we have over 250 members, most of whom are actively engaged in pushing the ideals of the group. We have received a large number of compliments on the first issue; and although we can see the deficiencies that are bound to creep into a limited staff operation we at Headquarters feel that the whole Society can be proud of our joint achievement.

Nevertheless, unless we get more help with the magazine and the Society, the JOURNAL cannot grow as the Society should. We are late this month with the JOURNAL...main reason was lack of material. We cajoled and begged, pleaded and prayed, but only the authors whose excellent contributions you see in this between these covers were really sufficiently interested to sit down and work for <u>your</u> Society. This member——disregarding the editorial "we" for a few lines——has an engineering living to make and just could not take anymore time to write a second article for this issue. The last issue was a one man operation with long hours that simply cannot be repeated every time. Even the "simple" job of logging in new members and making up cards for each one takes time, as does stamping and addressing the JOURNAL. In other words we need some help, if possible from people who are near to Headquarters so that we can get together and not have long delays in correspondence between us.

MEMBERSHIP

As we said earlier membership is growing, but not as fast as we would have liked. What we need is publicity, and word of mouth and enthusiastic members who gather new members. Will every member please try to get at least one new member before Christmas? If SBE is going to be the voice that it should be and accomplish what we need, and what we <u>can</u> do, we must have the support of all members, and all engineers must be members. There's no reason why we could not have 10,000 members within five years if everyone really talks and thinks SBE. And the way to make the SBE worth thinking and talking about is to add <u>your</u> contribution to the JOURNAL so that it is the first thing that every engineer reaches for on the first of the month——in the same way that every radio station member reaches for <u>Broadcasting and Telecasting Magazine</u> every Monday!

CHAPTER CHAIRMEN.

This month we welcome three new Chapter Chairmen. These gentlemen represent a wide area of the US. In Florida Martin Sandberg, Chief Engineer of WRHC Jacksonville, Florida has taken the lead in rounding up members and pushing the SBE. He also asks for the names and address of all Florida members. This we could not provide at once due to lack of secreterial help. So will all you Florida and South Georgia members please drop Sandy a line and give him your names, address, and telephone numbers. He wants to arrange a meeting at WJXT(TV) whose studios have very generously been offered.

In Montana, Kenneth J. Benner who is now a consulting engineer for KOPR in Butte Montana, and others, has accepted the job of Montana Chapter Chairman. He is also the author of an interesting and useful article in this issue on using the slide rule in a different way. He has also endorsed our suggestion of an SBE NET for Hams. So contact him all ye hams!

On the West Coast Al Browdy the doughty technical director of KCOP Hollywood, California has taken on the chores of California Chapter Chairman. We expect to be reading some of his literary works in the JOURNAL soon.

Gentlemen, we of the Society of Broadcast Engineers welcome you! This means that we now have eight chapters. Can we have some reports and news to print from each of you for the next issue? Deadline is December 1st.

FIRE!

The aftermath of the fire that destroyed all our records, and the editor's consulting engineering offices, apparently caused us to lose only four members' records. We still have the names taken from the deposit slip duplicate from the banking of their dues, but we don't know where they are. Their names are: Roos, Bryen, Lissner, and Bates.

Will you four please get in touch with us; or friends who may see this please tell them to write us.

MEMBERSHIP CARDS

Either with this mailing, or just after, members interim membership cards will go out to all paid up members. That's right <u>paid up</u> members! We still have a few members who signed up in a blaze of enthusiasm at NAB, and, then did not pay their dues! So how about it you two?

END OF THE FREEZE

Well the freeze's end came, but the net result has not been to produce a rash of station applications, although the first of the broken down Clears has been grantee for Roswell, New Mexico. In general, it is very difficult to find a town of any size today that can comply with the new interference---or overlap rules. And a point that might be missed by some applicants---if you have a pending application, and you want to amend it, or even modify a CP, you will have to comply with the <u>new</u> rules not those in effect when you applied or got your grant! This can be frustrating.

PINS AND CERTIFICATES

As noted earlier we have some temporary cards to be issued. Soon the membership should think about some certificates of membership, and a lapel pin. We have gone so far as to sketch up some ideas for pins, and the one that seems most applicable is in the shape of an 88 microphone with an antenna symbol growing out of a television camera, and a ground symbol coming out of the bottom of the camera. The letters SBE appear on the camera. Different camera colors would distinguish various grades of membership, and blue would form the background. That's just one idea. Of course we need many more before a decision is made. Can we have your own rough, or otherwise, sketches please?

PUBLICATIONS

A new magazine Broadcast Engineering and Management (BEAM) will be going to all broadcast station senior engineering and management personnel quite soon. It will be published by Mal Parks Jr. and edited by Verne Ray whom many of us know from Howard Sams publications. It is recommended reading for all members because it will be a professional level publication and being a monthly will carry topical and current information concerning SBE that might not appear for three month in SBE if the information came in just too late for a publication date. We hope to see Chapter Meetings listed in it so that no member has an excuse to miss one!

TELEVISION

Surprisingly enough, television allocations in the UHF band are going fast. In fact, in markets such as New York, Washington/Baltimore, Chicago, Los Angeles, etc. there is an FCC go-slow policy in effect. Until the FCC makes up its mind about the final table of allocations, applications and petitions to amend the tables in those areas are being held up.

One thing that we can look for in television perhaps soon, (at least as soon as the new table of allocations is finished) is the introduction to television of the counterpart of the local station on AM, and the Class A station on FM. Informed sources around the FCC say that there is a good chance of the staff recommending the introduction of local TV stations with a maximum of 10 KW from 500 feet. This would compare well with the other classes, and really is the back swing of the pendulum to the "Community Station" that appeared in the first television allocation plans.

JHB

NEWS OF MEMBERS

Congratulations to Ben Wolfe of KPIX San Francisco, California, who is one of our Steering Committee Members, on his promotion to National Engineering Manager for Westinghouse.

William (Bill) S. Orr has joined KARA-AM-FM as chief engineer, and is becoming consulting engineer to KHFM, both stations of Albuquerque, New Mexico.

We mentioned in our editorial that Kenneth Benner became consulting engineer for KOPR just as he took over the reins of the Montana Chapter.

NEWS OF CHAPTERS

The Binghamton Chapter (No. 1), Society of Broadcast Engineers held its first formal meeting 30 June 1964 at "Your Home Library", Johnson City, New York.

The meeting was attended by:

Bruce Mackey
WKRT AM-FM, Cortland, New York
Ronald Simpson
WPEL AM-FM, Montrose, Pennsylvania
Wiley R. Bates
WCHN AM-FM, Norwich, New York
Charles B. Lissner
WDLA AM, Walton, New York
L. H. Stantz
WBJA TV, Binghamton, New York
Donald Newman
WKOP AM-FM, Binghamton, New York
Gino Ricciardelli
WINR AM-TV, Binghamton, New York
Charles Hallinan
WKOP AM-FM, Binghamton, New York
George Sitts
WHEN AM-TV, Syracuse, New York

SUSTAINING MEMBERS

It is with the greatest appreciation that the Society of Broadcast Engineers lists the following organizations as Sustaining Members. It is their support that has helped make these JOURNAL issues possible, and we hope that from time to time we shall have the pleasure of publishing articles from the pens of their engineers.

The Alford Manufacturing Company
299 Atlantic Avenue
Boston 10, Massachusetts
Manufacturers of Antenna Systems, transmission lines and equipments, etc.

Burke and James, Inc.
321 S. Wabash Avenue
Chicago 4, Illinois
Suppliers of every conceivable form of photographic equipment for TV.

Electro Voice Incorporated*
Buchanan, Michigan
Noted for top quality broadcast microphones and loudspeakers.

Andrew Corporation
Box 807
Chicago 42, Illinois
Coaxial transmission line, switches, transmitting antennas and masts, etc.

Auricon Division of Bach-Auricon Corporation
6968 Romaine St.
Hollywood, California
Everyone knows that this is the home of the "Pro" and "Super-Pro" 16 mm S-o-F Cameras for TV

*Also an advertiser. SBE JOURNAL rates available on request.

Officers elected are:

Chairman - Charles Hallinan
Vice-Chairman - Gino Ricciardelli
Sec'y-Treas. - Louveer H. Stantz

Mr. George Sitts of WHEN, Syracuse attended the meeting to obtain information about the organization and plans to form a similar chapter in his area.

The meeting was devoted entirely to organization and discussion of future plans. The next meeting will be held in September. Meanwhile, each member will endeavor to recruit additional members. Application forms were distributed.

Forida #7: As soon as Chapter Chairman Martin Sandberg can get a list of members in Southern Georgia, and Florida he will call a meeting.

How about the rest of the Chapters? What's Going On?

COMING EVENTS

It will not be long before the Annual NAB Convention. Last year NAB very graciously gave us room in the Conrad Hilton on the first Sunday of the meeting. This was very much appreciated. However, a number of engineers who didn't arrive until later said "Gee, if we'd known about it we would have come". Well, it was in the NAB Official program, but it might be better placed later in the week. This is what we should decide well in advance. Probably we shall not be able to get free space from NAB if we hold it later, and it might have to be in an outside hotel. Your thoughts on this will help your committee formulate plans for Annual Meeting Number Two.

CONVERTING A MERCURY VAPOR HIGH VOLTAGE
TUBE RECTIFIER TO SOLID STATE OPERATION

by Harry A. Etkin
Staff Engineer - WQAL-FM
Philadelphia, Pa.

Radio Station WQAL-FM, Philadelphia, Pennsylvania uses an RCA type BTF-5B FM transmitter. The high voltage supply utilizes six type 8008 mercury vapor rectifiers in a three phase full wave circuit which furnishes 500 volts to the final stage and 1800 volts to the plate of the IPA.

A single section, choke input filter supplies 5000 volts at approximately 1.7 amperes to the plate of the power amplifier. The half voltage center tap of the high voltage transformer supplies the plate of the intermediate power amplifier through a double section RC filter which effectively filters and at the same time reduces the voltage to approximately 1800 volts. With the numerous outages caused by arc or flashbacks through the type 8008 mercury vapor rectifiers, the decision was made to design the high voltage power supply for solid state rectifiers with outstanding features to provide long trouble-free with maximum operational efficiency.

The original high voltage power supply schematic diagram is shown in Figure 1. After much deliberation, calculations, reviewing characteristic curves in the semiconductor handbooks, and seeking information and advice from silicon rectifier manufacturers, it was decided to use the CR110 silicon rectifier (RCA) or equivalent in the high voltage supply.

Peak Reverse Voltage	10000 Max. Volts
Peak Transient Reverse Voltage at + 60° to + 125° C	12000 Max. Volts
RMS Supply Voltage	7000 Max. Volts
D.C. Blocking Voltage	10000 Max. Volts

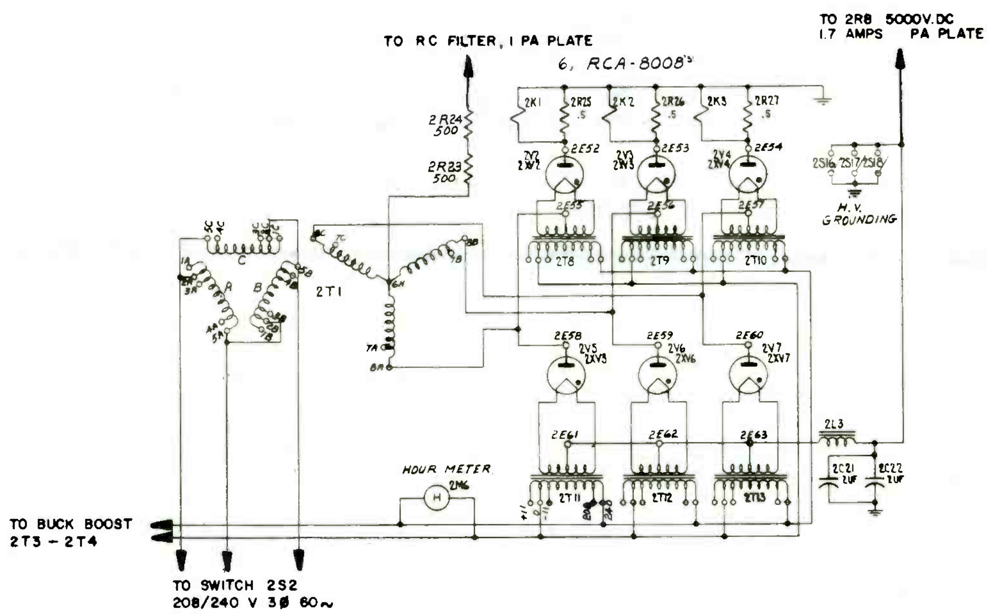

Figure 1. Schematic Diagram of Original BTF-5B High Voltage Power Supply.

The CR110 is a diffused-junction half wave silicon rectifier with a built in integral R-C Voltage-equalizing network. The major operating ratings are as follows:

Average Forward Current	
at 60° C	550 Max. Ma
at 100° C	210 Max. Ma
Peak Recurrent Current	5 Max. Amps
Peak Surge Current	15 Max. Amps

After considering this data, the CR110's were designed into a three-phase Y full wave rectifier circuit, the equivalent of the former tube rectifier, and the required performance parameters were calculated. These are shown in TABLE 1. The calculations indicated that utilizing the CR110 Rectifier in the high voltage supply would fulfill the requirements for supplying the required plate voltages and currents or the IPA and PA tubes. The circuit of the high voltage silicon rectifier is shown in Figure 3.

INSTALLATION

The first step in the installation of the silicon rectifier is to disconnect the voltage source from the primaries of the filament transformers 2T8 through 2T13. This is accomplished by removing the 208/240 volt 60 cycle single phase input from 2T10. Because the transformers are connected in parallel this will remove the input voltage from all the primaries.

TABLE 1.
REQUIRED PARAMETERS

DC OUTPUT VOLTS			AC INPUT VOLTS (RMS) INDUCTIVE LOAD		TOTAL DC OUTPUT CURRENT (LOAD)	CURRENT RATING PER RECTIFIER CELL INDUCTIVE CHOKE INPUT FILTER				PEAK REVERSE VOLTS PER CELL (PRV)
AV	PEAK	% RIPPLE	PHASE	LINE TO LINE		AV	RMS	PEAK	RATIO PK/AV	
EAV	1.05 X EAV	4.3	ERMS .428 X EAV to NEUTRAL	1.73X ERMS — .74X EAV	IAV	.333 X IAV	.578 X IAV	1.00 X IAV	3.00	1.05X EAV — 2.45X ERMS

EAV = 5000 VOLTS DC
IAV = 1.7 AMPERES DC

DC OUTPUT VOLTS (EAV) = ERMS/.428

CONSTRUCTION

For simplicity of operation and replacement the CR110 was mounted and wired into a 8008 tube base. Six defective 8008's were utilized, their glass envelopes were removed, and the six bases and plate connectors were retained for mounting the six CR110 rectifiers.

Although the high-voltage silicon rectifier can be mounted in any position, it is recommended that the rectifier be mounted on a vertical surface to prevent an accumulation of dust on the surface between the rectifier terminals.

Connections to the solder lugs of the rectifier should be made with 16 gauge or smaller diameter wire. Care should be exercised during the soldering operations to prevent over-heating of the rectifier terminals. During prolonged heating use the jaws of the pliers for a heat sink.

A word of caution, when removing the 8008 tube envelopes, be careful not to break them as a small quantity of mercury may enter the tube base. The mercury causes a chemical reaction which contaminates, and then disintegrates a solder joint. Therefore make sure there are no mercury deposits in the tube base!

The overall dimensions of the CR110 are 5½" in length, 1" high and 1" wide, the anode and cathode terminals are spaced 4" apart.

Mounting details are not given. Dimensions of the hardware and mounting parts will vary and will be left to the discretion of the station's engineering and maintenance departments.

Remove the filament line leads from transformer 2T12, which is connected to line voltage meter 2M5 through line switch 2S15, and connect them to the two leads previously removed from transformer 2T10. This change will continue to measure the filament line voltage which passes through buck-boost transformers 2T3 and 2T4. This will permit the measurement of the exact adjustment of the line voltage to that required by the taps used on the primary of the filament transformer 1T1 for IPA filament and 2T7 for PA filament.

The conversion is now completed. There are no other changes. Remove the six 8008's from their sockets and replace them with the CR110's, connect the plate caps to the CR110 anode connectors. The transmitter can now be put into operation.

With no changes in the high voltage supply overload relays, the control circuits will still provide a 45-second starting sequence which prevents the application of plate voltage until the blower is in operation, IPA and PA filaments have reached operating temperatures and the exciter has become stabilized.

The power transformer windings of 2T1 is sufficient to act as a surge limiting impedance to limit the surge current.

OPERATION

There is no change from the normal operating procedures of starting, tuning, and stopping the transmitter. A major difference in operation is

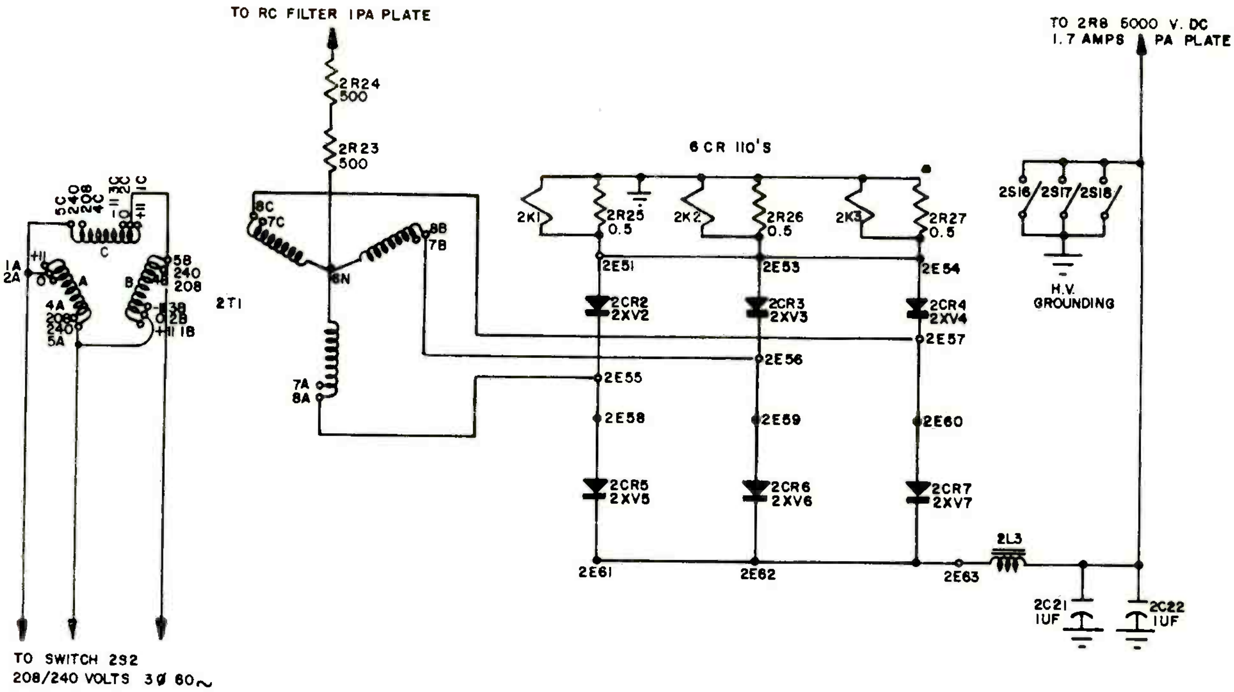

Figure 3. Schematic Diagram of the High Voltage Silicon Rectifier Circuit.

lack of appreciable heat radiation in the rectifier compartment, instant operation of the rectifiers, removal of filament supply load and, due to the constant voltage supply, the transmitter is more stabilized.

MAINTENANCE

With ordinary care a minimum of service will be required to keep the silicon rectifiers in operation. However, the condition of the silicon rectifiers should be checked by measuring the resistance of each rectifier in the high voltage supply with an ohmmeter at regular intervals. The forward path of each rectifier should measure a low resistance, while the reverse path should measure a high resistance.

This regular routine check will help to avoid interruption to broadcasts, and contribute in a large measure to overall peak efficiency in the operation of the station. We have found that conversion to solid state is a great step forward as far as operation and maintenance are concerned.

NOTICES -

Articles are needed! For subsequent issues, we need material, and the more the merrier! 1500 - 2000 words maximum unless very important and only line drawings until further notice please.

The Society of Broadcast Engineers acknowledges with very sincere thanks the efforts of the authors who have contributed time, effort and articles for this issue and looks forward to seeing their names on future contributions.

Burke & James have just issued another of their giant photographic and graphic arts catalogue. It is probable that Burke & James can supply any television photo or graphic request off the shelf or in very short order. Reader can obtain copies of this catalogue by writing Burke & James, 321 S. Wabash Avenue, Chicago 4, Illinois.

READERS' MAILBOX -

Letters are invited and as many as possible will be printed each issue. They may be edited if necessary for reasons of length. Address to Editor.

VISUAL ELECTRONICS CORPORATION OFFERS NEW AM-FM QUALITY BROADCAST TRANSMITTER LINE

Visual Electronics Corporation of New York, will market a new quality line of AM-FM broadcast transmitters, it was announced recently by James B. Tharpe, President of Visual.
The new line will include FM transmitters of 10, 50, 250 and 500 watts, plus 1 KW, 5 KW, 10 KW, and 20 KW versions, while the AM transmitters will be 1, 5, 10, and 50 KW models. The FM transmitters are designed for precise, stable operation with stereo and/or SCA subcarriers. A companion stereo generator is also available.

ELIMINATING THE MENTAL ESTIMATE IN SIMPLE SLIDE RULE OPERATIONS

by Ken Benner
Former Chief Engineer
KOPR
Butte, Mont.

In the past seven years, since picking this little gimmick up in a correspondence course, I have met only one person who had studied a similar idea to take the "guess-factor" out of simple multiplication and division with the C & D scales. This can, and does, become a headache particularly when we hit a problem where there are multiple operations to be performed. If mastered, the method offered below will eliminate mental work, and to a certain extent, aid in the accuracy of one's slide-rule use.

Practically every slide-rule manual advises one to approximate the problem in your mind to give the probable decimal point placement. This combined with the inherent inaccuracy of the slide rule has created considerable distrust in its use.

This method is merely the use of scientific notation carried a step further. However, in this case we always place the decimal point just before the first significant digit of any number. For example in the number 5,678 we move the decimal point four places to the left instead of three as in scientific notation, and say we have "plus four L-digits". "L-digits" are digits left of the decimal point and "minus L-digits" are zeros between a decimal point and the first significant figure. .1234 has zero left digits, .01234 has a minus one left digit, 1.234×10^{-8} has minus 7 left digits.

Now a few easy rules to file in our minds.

When multiplying:

1. If the slide moves to the left, add <u>algebraically</u> the number of L-digits in the problem, and this will be the number of L-digits in the answer.

2. If the slide moves to the right, again add <u>algebraically</u> the number of L-digits in the problem only here also subtract one L-digit to find the number of L-digits in the answer.

Let's take two examples:

1. 0.065 x 4,800

   Set up the problem and you will get these digits off the D scale: 3, 1 and 2. Since the slide moved to the left we simply add the L-digits in the problem. .065 has a minus one, 4800 has a plus four, -1 +4 = 3. Thus our answer is 312 obtained without any mental estimating.

2. 0.00234 x 34.5

   Set up the problem and get these digits:

   7, 7 and 2.
   In this case the slide moved to the right so we follow rule 2.
   .00234 has minus two L-digits, 34.5 has a plus two L-digits, -2 add algebraically to +2 is zero, subtract one (per rule 2) leaves us with a -1 L-digit. Thus, our answer is. .0772.

When dividing: (Using this system we must use the C & D scales in division also)

Look at the problem as a fraction:

1. If the slide moves to the left, algebraically subtract the number of L-digits in the denominator from those in the numerator, this gives the number of L-digits in the answer.

2. If the slide moves to the right, algebraically subtract one to the number of L-digits in the denominator and subtract the result from the number of L-digits in the numerator.

Let's try two division examples:

1. 784/ 0.0862

   Invert the problem as usual, between the C & D scales, and under the right C-index find the digits 9 and 1. Looking at the problem, we see we have plus 3 L-digits in the numerator and minus 1 in the denominator. Algebraically subtracting (-3) - (-1)=+4, and our answer is 9100.

2. 0.0094/ 0.044

   Proceed as in the above example as far as getting digits 2, 1 and 4 off the slide rule. In this case, since the slide moves to the right, we subtract one L-digit from those in the denominator, .044 has minus 1, subtracting 1 leaves minus 2.
   .0094 has a minus 2. Subtracting a minus 2 from a minus 2 leaves zero L-digits. The answer is therefore .214 .

The only thing to be mastered with this system is properly adding or subtracting L-digits, however, once this is practiced and the habit formed you will find that confidence in the slide rule grows fast.

SOME THOUGHTS ON EDUCATIONAL TELEVISION

by Rowland Medlar
Chief Engineer WUFT-TV
University of Florida
Gainesville, Florida

A tool might be defined as an instrument capable of changing the direction or intensity of a force. Although a purist might diagree, surely the psychologist would agree that this force might be construed as mental, and the result could take the form of prejudices or education.

The advent of Educational Television has provided a tool, the magnitude of which is yet to be determined. At least, at the present state of the art, Educational Television is not per se education, nor even a teacher, but merely a tool. It is simply a method of making the instructor's arms longer and his voice louder. But it does give the instructor a method of crowding an unlimited number of students around the laboratory table, and assuring that each one sees the same result. It gives him a method of bringing rare specimens and photographs to classes without hazard to the specimen itself. It gives him a method of displaying one-shot phenomena to great numbers of students; and furthermore, to repeat displays of the same one-shot sequence. It allows him to practice and perfect his presentation without fear of misinterpretation or varied results with different classes. To the pedagogically inclined, this may not be good, as we are beginning to see the word "stereotyped" appearing more frequently in the literature. To the engineer trained in the television art, problems arise to make us sorry that our forebears ever started the whole thing.

An educational TV station cannot be operated as a TV station nor as an educational institution. Programming is of such a vastly different nature that staffs of conventional TV stations hardly recognize it. There is no such thing as building the suspense of a drama to the proper pitch prior to the commercial cut. The entertainment value of a show is not considered. As the pendulum swings, it often swings to the extreme and certain educational programmers have stated that the station's rating with the public was of absolutely no consequence. However, it is becoming apparent that a certain amount of entertainment makes a lesson easier for students to digest, and at the same time makes "open-circuit" broadcasts almost palatable to the public. The teacher must be at once a showman, an authority in his subject, and a psychologist while realizing that John Q. Public is watching and criticising his methods while paying his salary. Such a teacher is a rare bird!

The engineering staff responsible for capturing this rare bird is in a no less precarious and unique position. Almost without exception, they are faced with non-photogenic, non-artistic, non-thespian, non-cooperative talent who see in their efforts a means of terminating of their employment! The customary absent-mindedness of the college professor comes to the fore. If the professor decides he wants to lecture on the dark side of the room, it's the engineer's fault the gamma falls too low. A voice trained over interminable years to subdue the back row of the classroom usually completely subdues a mike and sometimes requires three hundred and sixty degree VU meter scales. Art work bears no semblance to the three by four aspect ratio; and colored art work especially forgets all about reflectance values. In short, the engineer is faced with the problem of picking up existing material under varying circumstances with non-tv talent, but is required to produce consistent results. Contrary to what might be imagined, one seldom hears real complaints of the lack of artistic or esthetic values. But complaints of illegibility and unintelligability constantly haunt us. The fact is that the present American standards of T.V. transmission simply do not meet the demands of educational T.V. in many respects.

To crowd the detail needed for reading or without scanning a whole page of a book into a 525 line raster is a physical impossibility, without even considering the job of maintaining band-width and resolution. To educate the educate the educators that the medium has limitations is to remain continually on the engineering defensive. At the University of Florida we are leaning more toward closed-circuit systems where a semblance of wide-band operation can be maintained. This is incompatible with several of our circuits where the demand is for multiple programming on the same cable. Furthermore, the requirement of the engineer in ETV is to deliver a consistent visual and aural presentation to the student. not merely to the antenna or line terminals. In other words, his final product is actual light and sound in the classrooms---not only proper waveforms on the station monitors.

The demands on the medium are far more stringent that those on entertainment type TV. When a geometry teacher draws a circle on the easel, he sees absolutely no tolerance allowing it to come out an elipse on the viewing screen. Then, it is of extreme importance that the geometric distortions and linearities of the cameras and monitors be held to very close specifications. When the art instructor makes a point of shadow detail he cannot be convinced that there is such a thing as differential gain, or non-linear transfer characteristics, and please remember this covers the path from studio light to classroom light. When the language instructor makes a fine distinction in the sibilance of a pronunciation which is received by young ears capable of hearing the 15 K.C. overtones, he cannot be easily told that the band-pass of the audio system including the three inch set speaker is not perfect.

Looking from the student's point of view we find that the public has been so long indoctrinated with commercial soot- and-chalk pictures he actually finds a rendition based on a linear grey scale repulsive and consistently attempts for abnormal contrast and brightness. The public has been so long trained that a TV set should sound like a "tv set" that a student is really shocked by a semblance of hi-fi and complains when the sibilance the professional teachers develop actually comes through. A side line to the audio is the extraneous sounds of the sweep circuits, particularly at 15.75 K.C. These youngsters, with the extended responses of young ears, suddenly find themselves actually having to pay attention to a TV set rather than having it as a background noise which has become one of the subconscious aspects of American life. An educational producer must of necessity be exceptionally critical of picture cut-off area. This stems from the need to transmit existing subjects rather than having full control of set composition. More often than not the areas near the edges of the picture are as important as the center. It is of little benefit for an engineer to explain the vagrancies of beam-landing errors to a biology teacher who knows that he wants to show a microphoto of a paramecium whose cilia happen to lie in the extreme upper right hand corner of the field.

Storage of program materials is almost universally confined to Video tape. As those of us in the industry know, the tape medium is limited in resolution and stability. Great advances are being made. The fact is that the very advances pose a problem to the ETV engineer. Due to the wide gamut covered by the library of the ETV station, in our case ranging from third grade Spanish to post graduate Biochemistry, it is essential that some of the tapes run be quite old. The industry has not yet accumulated enough experience regarding very long storage times for video tapes. Seldom is a tape run on the same head recorded it. More often than not a tape is played on a head with vastly different characteristics from the recording head. Changes in equalization techniques and standards are commonplace. Standardization between stations swapping or "bicycling" tapes is far from complete. It is a game to have engineers look at excerpts of tapes and guess which station in the chain made them.

The answer to these problems is simply to utilize better and more precise equipment throughout. Unfortunately these things cost money and to date the experimental nature of ETV has caused the powers that be to hesitate before making huge expenditures to up-grade a mediocre product. The available quantity and quality of staff personnel is obviously limited by this aspect also.

Production schedules are completely different from Commercial TV. At WUFT it is not at all uncommon to have four different programs occuring simultaneously. This could be: A taping session, an open circuit, one or more closed circuits, and feeds to other stations; not to mention the interminable viewing and editing sessions. The confusion is augmented by the fact that there are three standards of time for switching; campus time for closed circuit activity, EST for open circuit broadcast, and producer time at the whim of whenever he is ready to tape. Together with the various intercoms, telephones, and verbal clamor one wonders how anything ever comes out right.

In some shops, ours for example, there is an engineering student training function. We lean heavily upon electrical and communications majors for part-time help. Although academic credit is not given, the students consider it a supplement to their laboratory work. We consistently get reports that a student gained more practical knowledge with us than in regular class. This is good and is a service. Still it is understandable that it puts the nucleus staff (in our organization only six men) under quite a pressure for the student staff rotates by the tri-mester term with a new group coming to work three times per year. Proficiency suffers and grows correspondingly in cycles.

In any organization there are always some inter-departmental prejudices and frictions. With ETV it is not uncommon for instructors to refuse to let certain class room presentations be shown to the general public. This is understandable in that one lesson or portion of lesson taken out of context by a casual viewer could spell diaster for the individual instructor. The net result of such a situation is that the ETV engineer is faced with running two or more separate stations simultaneously. What the public sees is definitely not representative of what the station is doing. To compound this dilemma in general the open-circuit aspects of the operation usually take second priority and the public impression of the station deteriorates.

The management leader of an Educational Television Station is likely to be a man with a background primarily in Education. His problem is to augment an educational system with a tool at the least expense to serve the most students with the best instructions. His job is certainly not enviable. In view of the limitations, some of which we have pointed out, he is faced with an ever present myriad of dissentions demanding that he justify his very existence. His budget can look fantastic, primarily because the new media is under close scrutiny as opposed to the accepted costs of conventional educational systems. The lack of standardization in the new industry necessitates redundancy of effort that is not economical. The observation of his high points of achievement is limited to so few people he generally takes the role of an unsung hero.

At the outset of this new branch of electronic endeavor the novelty of the situation caused a substantial stir in the hearts of many proficient engineers. We came in droves to new pastures. The rewards have been multiple and in themselves sufficient. The hard facts of life are beginning to catch up with the movement and we now begin to see a recession of interest. In fact a number of these engineers are filtering back to the commercial industry. The reasons are manifold. Since the majority of Educational Television installations are under the control of some Governmental branch, there is little opportunity for unified labor organizations. As with any new organizations. As with any new organization the growth is not accompanied by a commensurate addition to staff. The work load reaches the breaking point before the need for adequate personnel becomes apparent. The educational aspects of Educational T. V. work bilaterally. While commercial operating is stabilized to the extent of approaching a mundane status, the new challenges for higher quality and broadened scope force the engineer in this new field to advance. Not only does he advance in technology but the very cultural atmosphere rubs off on him and he finds speaking terms with academic subjects he never before considered.

It is not unusual in our shop for the engineer during a language production to catch himself using the intercoms in the language being taught. Suddenly the engineer faces the fact that he has advanced to the point where he can demand a better job than he left commercially and the pastures look greener at the old stand. In short, the novelty is disappearing. No doubt the pendulum will trace out a long and slowly damped oscillation of engineering vacillation between commercial and educational employment. But the rewards of ETV are great. An ETV engineer will always be able to point with pride to the job he is now doing toward upgrading the state of an existing art. It can conceivably be the major tool in preserving our educational system which would otherwise have succumbed to the sheer weight of the numbers of students rightfully demanding their proper place in an enlightened world.

FREQUENCY MODULATION NETWORK RELAYS

by Norman J. Gagnon
Consultant
Suncook, N.H.

Since the early days of Major Edwin H. Armstrong and his new discovery, Frequency Modulation, it has been recognized that FM provides the best mode of radio transmission and reception in all types of atmospheric conditions while still maintaining full fidelity response.

"Were I to make any prediction.....on the matter of FM networks..... it would be that the ease with which relaying can be accomplished, and the excellence of their performance will be the next surprise." Those were the words of Major Armstrong in 1943.

In 1947, Major Armstrong demonstrated the "Continental Network" to the NAB Convention. The network spread from Washington, D.C., up north to the peak of Mount Washington in New Hampshire, and as far west as Niagara Falls, New York. Comprised of 18 FM stations, the network used both land line and off-air relay facility.

Since those early days the use of an FM facility for program forwarding and the forming of regional networks has been steadily on the increase. FM networks range from the large and extensive webs to those linking two or three stations.

Some nets were set up to distribute programs to local and regional AM stations via a powerful FM station in their area. This FM network idea was excellent in concent, and still is, but with the increased interest in FM, many stations would like to program separately and yet still relay programs to their network. Among the large webs, serving FM stations exclusively, in the QXR network.

With the inovation of the multiplex channel, it became possible for a radio station to forward programs to a network on one of its subchannels while maintaining a separate program schedule on the main FM channel--in either stereo or mono. It also made it possible for a station to relay two different programs simultaneously.

A TYPICAL NETWORK

The knight quality stations of New England comprise five stations which are located in Manchester (WGIR), Portsmouth (WHEB), Claremont (WTSV) and Hanover (WTSL) all New Hampshire. The fifth outlet (WEIM) is in Fitchburg, Mass.

A few years ago a regional netwrrk was set up with WGIR, becasue of it's central location, as the key station. Network programs came into the Manchester studios via AT&T facilities. Here they were processed and sent to the knight stations through two separate TELCO lines. One leg went to Fitchburg, the second to Claremont/Hanover.

After construction of WGIR-FM it was planned to use the FM facility to relay programs to the knight network on a 67KC subcarrier channel. Furthermore, WGIR, was to obtain its network programs by use of an off-air **pickup**.

WGIR is affiliated with the Yankee Network and the Boston Sports Network, both of which are regional networks covering all of the New England States. These networks are headquartered in Boston, which is some 55 airline miles south of WGIR's Manchester studios. WRKO(FM) is the key station for the Yankee network, while the sports network is fed thru WHDH-FM. Both outlets are Class B stations, with maximum power for their antenna heights.

On a number of occasions WGIR relays a Red Sox or Bruins hockey game on the sports network on the main channel, while the 67KC subcarrier is carrying the Yankee schedule. The sub-channel can also be used for pre-feeding news cuts and programs, closed circuit information, and any other material that is not suitable for broadcast on the main channel.

EQUIPMENT

Flexibility and reliability were of prime importance in the planning of the network. In order to attain this goal three FM tuners were acquired for the studios. Two McMartin crystal tuned receivers are used, one for each of the Boston networks and the third is an REL continuously variable tuner used mainly as a back-up. This receiver can be quickly and easily patched in anywhere in the system whenever desired.

On the roof of the studio building are two separate "Yagi" type antennas mounted on a 20 foot pole pointing southward towards Boston. The upper antenna is feeding an FM distribution amplifier located in the FM receiver rack. The other antenna is used solely as a stand-by and can be connected either to the distribution amplifier, or directly into any of the tuners, should the need arise. The output of the distribution amplifier feeds all three receivers. This receiver and antenna arrangement makes it possible to have the two networks in several at all times, and, in addition, offers protection against component failure by switching to a substitute immediately if necessary.

The decision to use a distribution amplifier in the system was made at an early date. The reason for this decision use was that, in addition to requiring only a single antenna for all three receivers, it provides added signal strength at the receiver input. This makes it possible for the receiver IF limiter stages to operate well saturated. This took the operation out of the marginal signal strength area and improved the signal to noise ratio. It also minimizes the flutter and fading that accompanies the flight of an airplane through the signal path. Although this condition can still occur, it is not now noticeable in the audio, because the signal strength never drops below the threshold level required for 20 DB of quieting.

The receivers are mounted in a rack next to the control position in the master control room. This makes it possible for the engineer on duty to monitor the audio as well as the signal strength on the receiver's "S" meters. AC power to the rack remains on 24 hours a day, this provides better receiver tuning stability plus giving longer tube life. The audio output of all the tuners is divided into two lines, one feed goes to the console for local programming, and the other to the sub-channel switching box. This box is mounted at the control position, and allows the engineer on duty to select the correct audio source for relaying to the network. The control box has provisions for switching: NBC, Yankee, Sports Network, and the output of the audition channel from the control board. This switching arrangement makes it possible to relay any program material, either local or net, at a moment's notice. The output of the network switch is patched into a Gates "Levil Devil" amplifier, and this in turn is feeding the Mosley SCG-4 subcarrier generator.

OPERATION

After installing the switching system, it was found that not all program sources were at the same level. After a few months of operation, the difference in level was found to be very noticeable at the receiving end, and showed up as varying amounts of crosstalk from the main channel. It was then decided that a level as high as possible should be transmitted and maintained into the SCG-4. This helped to keep the crosstalk level down, because, before installing the "Level Devil" there was as much as 10 DB difference in levels--which meant a 10 DB increase in crosstalk when the level had to be increased at the receiving end. An FM limiting amplifier in the main channel also helps the crosstalk problem.

The WGIR FM transmitter site is 6½ airline miles west of the studio location, and is programmed and remotely controlled through a Moseley studio-transmitter link. Both the main and the multiplexed subchannel are carried by the STL, in addition to the control tones. Up on the hill the 67KC sub is filtered from the output of the STL receiver through a passive network. The subcarrier is not demodulated at the transmitter site. The output of the filter drives the exciter of the RCA BTF-1D transmitter, and an RCA BFA-6A antenna at 920 feet above average terrain. Feeding the subcarrier into the exciter without demodulation helps to keep the crosstalk level down. It has been proven that there is no noticeable increase in crosstalk when a subchannel is fed directly into another exciter without first demodulating it. Another advantage of this system is having the multiplex generator at the studio site, this enables the engineer to keep an eye on its operation, although this unit is very stable and rarely requires any attention.

The multiple generator is equipped with a muting switch which mutes the output of the generator after approximately a five second pause in programming. This muting system is excellent for background music operations, but when program relaying it was found to be advantageous to disable the muting. Provisions for monitoring both the main and the subchannels is at the studios and also at the transmitter site. This is very helpful in checkingout the operation in time of trouble.

After one year of operating this 100% radio network, much improvement over the former land line facilities was found, and the system was rated as over 95% reliable. There were many growing pains, but now these problems have quieted down—although the stations on the receiving end may tend to disagree with that statement on some occasions! Most of these problems have been human errors, such as forgetting to switch the proper program to the subchannel. There has been the usual crop of technical problems. All the receiving stations in the Knight network have a "Yagi" antenna, and are similarly equipped with McMartin crystal tuned receivers for both the main and sub-channels.

These "FM networks" allows small networks to be formed, linking stations for entertainment programs and also emergency information in case of a national or regional disaster, and without exhorbetant landlive charges that mount up even during idle periods.

LINE VOLTAGE PROBLEMS

by Bruce L. Mackey
Technical Supervisor
WKRT Radio
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Perhaps one of the biggest problems over the years for the broadcast engineer has been unstable line voltage. Such instability if it is sufficiently severe, will give even the best regulated power supply a hard time.

When fluctuating voltage situations arise, it must be initially determined what is causing the fluctuation. Possible causes are poor line voltage regulation on the part of the power company, inadequate building wiring, or an unbalanced or shifting load condition, the latter being particularly troublesome on three phase power circuit configurations.

WIRING DEFICIENCIES

Possibly the easiest way to determine the adequacy of building wiring is to check line voltage regulation on a circuit by circuit basis. The no-load circuit voltage of the circuit under test should be measured at the point in the circuit that is most distant from the fuse or circuit breaker box which feeds the circuit in question. Then the full load for which the circuit is rated should be applied at the point to which the voltmeter is connected in the above measurement. The voltage drop under full load when measured at this point should not exceed 2%. Should the drop at this point exceed 2%, measure the no load voltage at the fusebox terminals to which the circuit under test is connected. Then apply full load to the same remote circuit point as mentioned above. If the voltage drop as measured at the fusebox load terminals for the circuit under test is less than 2%, then the circuit wiring itself is to be suspected. It would be wise at this point to make sure that the circuit wiring is sufficiently heavy to carry the full rated load of the circuit. If it is not, the wiring should be replaced with the proper size. If on the other hand, the voltage drop when measured at the fusebox terminals under full load is the same as the drop measured at the most remote circuit point, even though this drop may be more than 2%, it is reasonable to assume that the circuit itself is adequately wired and that the excessive voltage drop is being caused by difficulties other than the circuit wiring itself.

POSSIBLE CAUSES OF HIGH CIRCUIT RESISTANCE

One frequent cause of excessive voltage drop under load is poor connections. These may exist at the input, or line side, of the fuse block or circuit breaker feeding the circuit in question, on the output or load side of these devices, or may exist because a circuit breaker has become defective, or a fuse has not been securely tightened in its socket. In the case of cartridge type fuses, often the clamps which make contact with the cartridge ends become dirty, or have lost the tension necessary to make good contact. Sometimes the latter condition can be remedied by employing cartridge fuse contact clip clamps such as manufactured by the Bussman Company.

To determine if the circuit protective devices are in satisfactory condition and connections are tight, measure the no-load and full load voltage of the circuit under test on the line or input side of the fuse or breaker which protects the circuit. If the voltage regulation is considerably more satisfactory at this point than at the points previously measured, the fuse, circuit breaker and connection points involved with these devices should be checked. If the voltage at the input to the circuit protective device reveals the same variation as in measurements elsewhere in the circuit, these protective devices and associated connections can be assumed to be satisfactory.

Another cause of unsatisfactory line regulation or continuous low voltage in a particular circuit, is unbalance between phases of a three phase power system or between legs of a three wire 240 volt circuit configuration. Such unbalance occurs when a considerably greater load is applied to one phase than another or to one side of a 240 volt three wire system than the other. The easiest way to determine the actual load on a given phase or circuit leg is to employ a clamp-around type ammeter such, as the AMPROBE JR. This unit should be clamped around the "hot" lead of the circuit under test at a point where this lead comes out of the electric service meter, or just before this lead enters the main power distribution panel, whichever is the more convenient location for making such a measurement. Only at these points will the total load of all the branch circuits on each phase or leg be indicated by the ammeter. The load should be distributed on each main leg or phase so that when all equipment connected to the branch circuits is on, the load on each leg will be about equal. If it is not, the load should be balanced as closely as possible by a qualified electrician. This will improve the voltage regulation on all phases or legs, as the tendency for the heavily loaded phase or leg to produce a lower output voltage with respect to the remaining phases or legs will be reduced.

FINAL TESTING

If satisfactorily determining that the building wiring is adequate, and that all primary feeder circuits are balanced with respect to load, and the voltage instabilities still exist, one final test should be made. Connect an accurate voltmeter to the line side of the main building power switch and throw the switch off. (Be careful...this stuff is hot!) Then measure the no-load voltage. Next throw the main switch on, and turn on all pieces of equipment which would be on in normal use. If the drop from no-load to full-load exceeds 3% under these conditions, the problem then belongs to the power company.

CONTACTING THE UTILITY COMPANY

The service department or business office of the local power company should be contacted and the problem stated to the individual in charge of such matters. Under most circumstances the power company will be happy to check on the unsatisfactory conditions.

According to power company sources, one of the most prevalent causes of low or poorly regulated voltage is that over the years consumers greatly increase their electrical demand without informing the utility of this fact. Frequently this increased load eventually exceeds the rating of the service transformers which supply the customer, and the line voltage drops excessively under full load, or poor regulation occurs. In severe cases the transformer may even burn out. The local power company is most anxious to preserve their transformers and to supply electric service which meets the standards of the Public Service Commission as for as line voltage regulation. The power company will most likely make arrangements to install recording voltmeters on the primary service line. These meters are very sensitive and will show even the slightest variation in line voltage. The recording facilities with which these units are equipped helps the power company to determine not only the extent of the voltage fluctuation, but the times at which these fluctuations occur. The utility will also check at the time such units are installed, the total KVA demand imposed by the equipment on the service transformer(s) which supply the line voltage. Should the demand exceed the KVA rating of the supply transformer(s) it will be replaced with an adequately sized unit. These transformers may be located outside the building on a pole or may be installed in a transformer vault.

In the event that the transformers which supply the electrical service are found to be adequate, the power company will usually check the voltage regulation at other points on the high voltage line feeding these transformers. If poor regulation exists at these points as well, the utility will attempt to determine the cause. Frequently the cause is merely that the increased population in a given area has produced increased demand on a given high voltage feeder circuit. Most power companies forsaw this possibility, and have installed adequately sized high voltage line conductors to meet this projected demand. Where this has not been done, poor regulation and low voltage often develop, and the only solution is the replacement of the high voltage transmission line. Another source of trouble can be traced to undersized, or defective, voltage regulators at the substation which feeds the transmission line in question.

The regulators and their associated transformers are also usually replaced occasionally to meet the increasing consumer demands, but even a brand new regulator can develop trouble.

RESULTS

When the power company has determined the source of the trouble and has taken corrective measures, voltage should be received which is maintained within plus or minus 5% of the nominal voltage for which the service is designated. This means for example, that a 240 volt three wire single phase service should deliver 240 volts plus or minus 12 volts or less, at all times. In practice, regulation is usually superior to this example. At the WKRT transmitter site, regulation is maintained to within plus or minus 2.5% on each phase of a 240 volt three phase primary supply under normal load situations, and within plus or minus 4% under the most severe conditions.

ADDITIONAL REGULATION

If the power company is delivering line voltage which meets the regulation standards of the Public Service Commission for this type of service, and this regulation is not sufficiently close for station operational purposes further regulation may be achieved by the installation of constant voltage transformers on the part of the station. Such units are available from the SOLA division of the Basic Products Company, and other similar sources, and are capable of handling loads from 1-100KVA at line frequencies of 50, 60, or 400 cps. These regulators will maintain output voltage within 1% for input variations as great as 20% and for loads which vary from 0-100% of rated regulator capacity.

THE WATCHFUL EYE

For the engineer who wishes to keep tabs on line voltage, a voltmeter of known accuracy such as the RCA Power Line Monitor Model WV-120A may be employed. This unit is quite inexpensive and offers greater accuracy within its expanded scale range than many higher priced instruments. The meter is of the moving vane type and is lightly damped, making it suitable for indicating even small rapid line voltage fluctuations.

CREDITS

The author wishes to thank the Niagara Mohawk Power Corporation, and Mr. Vincent Moore (Manager of the Cortland, NY office), for their cooperation and assistance.

BOOK REVIEWS

Radio Operating Questions and Answers, 13th Edition by Jules L. Hoanung and Alexander A. McKenzie. Published 1964 by McGraw-Hill Book Company, 330 W 42 St., New York 36, N.Y. Price $8.25.

Many members will have had more than a nodding acquaintances with earlier editions. This one is well up to the authors' earlier standards and contains items of interest to most station technical personnel. In particular the junior engineer who is ascending the license ladder will find this book invaluable---so will the station managed.

Among this 13th Edition's important features are: a complete rewriting of Element 1, contain ing all new questions and answers, twelve new Q's and A's on Element 2; and the completely new Broadcast Operation Element 9, with thirty comprehensive questions and answers.

As in previous editions, the questions are conveniently grouped in general categories, according to topics such as laws, power supplies, theory, etc. Of special interest is the time signal information, word lists, resistor and capacitor color codes, and other useful information found in the appendixes.

This book is specifically designed to give essential, practical information to radio technicans, servicemen, and engineers studying for one or all of following licenses:

RADIOTELEPHONE OPERATORS
First, Second, and Third Class
RADIO TELEGRAPH OPERATORS
First, Second, and Third Class
RESTRICTED RADIOTELEPHONE PERMIT
AIRCRAFT RADIOTELEGRAPH ENDORSEMENT
SHIP RADAR ENDORSEMENT

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National Electrical Code Handbook. Eleventh Edition, revised by Frank Stetka. Published 1963 by McGraw-Hill Book Company, Inc. 330 W 42 St., New York 36, N.Y. Price $12.50.

This is a very useful book for the engineer who has, or will have, electrical wiring problems to solve.

In this book you will find detailed information on: Wiring Design and Protection; Wiring Methods and Materials; Equipment for General Use; Special Occupancies, Equipment, and Conditions; and Communication Systems--all with numerous illustrations. In addition, you are given reference data and tables, plus worked-out examples for computing loads and capacities. An appendix covers the rules of procedure for establishing and amending the Code.

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Application is hereby made for membership in the ~~Institute~~ Society of Broadcast Engineers w~~ith the grade of *.................~~.. The following information is supplied to assist the admissions committee in assessing my qualifications. Grade

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~~Position ....~~

Employer ....

~~**~~ Address .... City State
check Preferred mailing address

Engineering Qualifications ....Degree?........University...........Year.....

FCC Licenses..............
Years of Responsible Engineering Experience......
Brief Professional History.......

Fields of Engineering Activity...Radio....Television....Transmission......

Studio....Other.........

Two References who are Familiar with my Work

Name and Address......

....

Name and Address......

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Annual Dues of $10 are enclosed herewith (no action can be taken if dues do not accompany application). I agree to ~~follow~~ abide by the Constitution and By-Laws of the ~~Institute~~ Society if admitted. Signed.......................Date.......

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~~* Until By-Laws are adopted all members enter as Charter Members.~~
~~** Indicate Mailing Address Preferred.~~