IEEE

NEWSLETTER

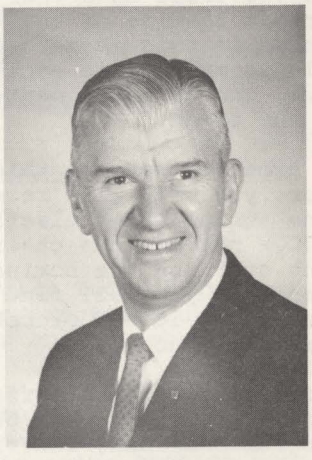
VEHICULAR TECHNOLOGY GROUP

NOVEMBER 1974

MESSAGE FROM THE PRESIDENT

Remember the old adage about "taking the boy out of the farm but not being able to take the farm out of the boy"? Well, I'm beginning to wonder if the same may be said about some of us IEEE members! Perhaps some of you will recall an article in the June 1972 issue of Spectrum written by Gordon Friedlander of the HQ staff dealing with the life of Nikola Tesla? This article generated so much interest that a special session was devoted to Tesla at Intercom in New York City last March. I attended that session and was really impressed with the attendance. Must have been close to 100 members present. What a tribute to this early pioneer in the history of electricity and electronics: As it turned out, I found that Nikola Tesla was born and raised in a little town of Smiljan, Yugoslavia, about 100 kilometers south and west of the Croatian capital of Zagreb. How interesting! My travel plans this year included visiting the birthplace of my wife's relatives somewhere near Nikola Tesla's birthplace during my visit to Yugoslavia in August.

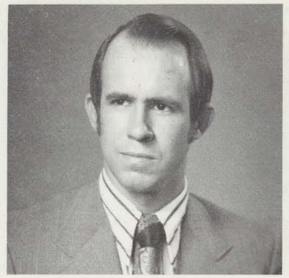
Because of the general interest in the life of Nikola Tesla in the United States and the lack of photographic information about his early life, I made it a point to visit Smiljan and record such information as was still available at his birthplace. Although some of my slides are still being processed at this writing, the few I do have look very interesting. To paraphrase the old adage I quoted from earlier, "you may take the IEEE member out of the country but you can't take the IEEE out of the man."



NICHOLAS ALIMPICH

So goes it with me - IEEE HQ had influenced me enough to carry on an IEEE mission while on vacation! Should there be history buffs within the IEEE or VTG especially interested in Nikola Tesla, maybe we can get together and exchange information. For the moderately interested, Nikola Tesla is considered to be the father of alternating current as you know it today.

EDITOR'S NOTES



In addition to the regular columns from the newsletter staff Editors and President Alimpich, this issue of the newsletter contains several interesting contributions from others that I would like to call to your attention.

- Sang Rhee has provided us with a full background story, complete with photos, on the highly successful 3rd annual Microwave/Mobile Conference in Boulder, Colorado.

- A timely article on the status of the VTG membership by Andy Missenda, the membership chairman, is included. In passing, I would like to comment that an oscilloscope waveform of the membership totals looks very much like a periodic triangular waveform, the average being level on a year-to-year basis. A current listing of the VTG membership is included in this issue. So please pass the included membership reply card on to a colleague, who is not a member, and let's change the trend.

- At about the time you receive this issue of the newsletter, you will also receive a ballot for the annual ADCOM election. Bob Bloor, the ADCOM nominations chairman, has an interesting story on the nomination process. I believe you will find Bob's article informative, it's a process that few of the members know much about.

- With the upcoming silver anniversary convention in Toronto in January, Art Dinnin, the technical program chairman, contributed an article designed to whet your appetite. I am also indebted to George Berman who made arrangements with the Toronto Convention and Tourist Bureau to send me information for a stimulating story on Toronto. I believe you will be inspired by Toronto's story, it's truly a great city.

We have a new addition to the newsletter staff. Carroll Lindholm has agreed to serve as the Book Review Editor. Carroll does not have a column in this issue, but he's aiming for a book review section for the January issue, and on a regular basis thereafter. If you have any suggestions as to relevant and interesting books, please pass them on to Carroll.

I would like to thank everyone who contributed to this issue of the newsletter. And true to form, the newsletter staff Editors came across with timely inputs to me for their columns.

Now I'm sure you will want to thank me for ending this note.

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VTG NEWSLETTER DEADLINES

Month of Issue	Final Copy To Be Rec'd By Editor	Target Mailing Date
January	12-2-74	12-30-74
April	3-3-75	3-28-75
July	6-2-75	6-27-75
October	9-1-75	9-26-75

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CHAPTER NEWS

BY: JOHN DETTRA

ORLANDO W E L C O M E

A new chapter has been formed in the Orlando, Florida, area having elected George F. McClure, Chairman; Melvin C. Kelch, Vice Chairman; Herbert J. Zwarra, Secretary; George M. Dewire, programs; Bud Simciak, Arrangements; and David W. Bozman, Membership. At the first meeting, 13 attended and elected the above officers. The number of IEEE-VTG members has grown to 29 and they expect to sign-up 25 new members before the end of the year.

COLUMBUS Meeting every month.

Columbus is only chapter reporting meetings since last newsletter.

"Worldwide Communications via H.F. Radio"
by Bill Gary on July 10, 1974, 13 attending.

"Transportation Research Center of Ohio"
by James H. Leckrone on September 11, 1974, 17 attending.

"Brief Biography of Participating Individuals Responsibilities"
by Max Hart on August 14, 1974, 10 attending.

SE MICHIGAN

Up-coming meetings.

Nov. 14 "Selection of vehicle antenna based on radiation pattern analysis".

Dec. 4 "Optoelectronics for automobile applications".

New Officers: Ken Niemi, Chairman
Bill Fleming, Vice Chairman
Verne Caron, Secretary

DALLAS-FORT WORTH

The Dallas-Fort Worth Chapter of IEEE - Vehicular Technology Group has 48 current members. We are planning to have five programs during the period to July 1975. Meetings are planned in October and November, 1974, January, March and May, 1975.

Our first program will be held in Dallas on Thursday, October 10, 1974:

Speaker - Mr. Ray Trott - Director of Engineering DECIBEL PRODUCTS, INC. Dallas, Texas
Subject - ANTENNAS, COMBINERS, DUPLEXERS AND FILTERS USED IN MOBILE RADIO COMMUNICATIONS

Our next meeting will be on November 14, 1974 in Dallas - Program to be announced.

HELP Anyone in the Chapters of:

Los Angeles San Francisco Miami Syracuse
Toronto Montreal Omaha

Will someone in these areas please contact me to help activate your local chapters?

SEND Meeting announcements and abstracts of past and future meetings to the Chapter News Editor for exchange of ideas and activities with other chapters.

AUTOMOTIVE ELECTRONICS

DATELINE: DETROIT

BY BILL FLEMING

UPDATE

During the past months, a number of news items concerning developments in automotive electronics have caught my attention. I thought it would be of interest to briefly review these items as follows:

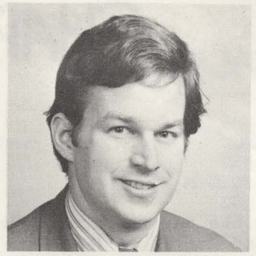
1. "A Federal push for electronic automotive diagnostic inspection systems is expected from the National Highway Traffic Safety Administration. By law the agency is empowered to fund automated or semi-automated systems which will test vehicles for compliance with mechanical safety and emission control standards. Up to 90% of system cost will be paid by the Government; however, the White House Office of Management and Budget has yet to give the agency significant funding for this work. Currently, the agency is querying industry as to off-the-shelf technology" - *Electronics*, p. 59, April 4, 1974.

2. "Burroughs Corp. of Detroit has begun a big push for auto electronics sales. The company's Electronic Components Division is promoting new displays intended for vehicle instrument panels. The displays utilize gas plasma technology and feature a novel self-scan bar graph display. A demonstration panel includes display simulation of variation of miles per gallon efficiency as a function of road speed. Other dual panels display conditions of water, fuel, battery, and oil systems. A circular bar graph shows engine rpm. In addition, there is a message center panel for communicating to the driver a variety of information." - *Detroit Free Press*, June 16, 1974.

3. "A novel warning system installed on 343 San Francisco cabs and used for 12.3 million miles has cut rear end collisions by over 60%. An amber warning light, center-mounted on the rear of each cab, was designed to give the following driver information about the cab's deceleration. Activated by the brake pedal, the light flashed at a rate, duty cycle and intensity,which varied exponentially with deceleration." SAE Paper 740614, Abstracted in *Automotive Engineering*, p. 20, September 1974.

4. "A low cost, accurate pressure transducer for the 50-1000 psi full-scale range has been developed by Kulite Semiconductor Products, Inc., Richfield, N.Y. The transducer was reported to suffer only one failure in 310,000 miles while in use for monitoring air and oil pressure in diesel truck engines." *Electronics*, p. 128, September 5, 1974.

5. "Rockwell Microelectronics has begun production on its first venture in the automotive field -- a microprocessor designed to control automatic wheel anti-lock. The digital microprocessor was developed in conjunction with the Automotive Operations Division of Rockwell-Standard group. The system, a proprietary design called Skid-Trol, will use a P MOS/LSI microprocessor. Mr. Emil Achee



of the Microelectronics Device Division said that his Industrial Electronics group was working on further automotive products. In particular, they are looking at those areas where safety regulations have the force of Federal legislation behind them. One current project is an engine control device intended to maximize economy and performance, and to minimize emissions. He estimated this system would appear in cars by the late 1970's" - *Electronics News*, p. 43, September 9, 1974.

6. "After more than a year on automobile production lines, says Vanzetti Infrared & Computer Systems, Inc. of Canton, Massachusetts, the reliability of its infrared radiation-detection systems has been proved. Presently, it is being used to monitor induction heating of camshafts and valve seats in engines. As more metal parts are replaced by plastics, there is interest in putting the fiberoptics used to sense infrared into injection machines to measure temperature." -- *Electronics*, p. 42, September 5, 1974.

CONVERGENCE '74

Several hundred attendees representing leading automotive and electronics industries throughout the world will meet at the Somerset Inn in Troy, Michigan on October 28, 1974 to participate in the First International Colloquium on Automotive Electronic Technology. The two and one-half day colloquium will consist of four technical sessions that will explore current and future growth of electronics for the automobile. Subjects to be discussed include recommended practices, state-of-the-art technology, applications and projected future course of automotive electronics.

Twenty-five internationally prominent executives of both the electronics and automotive industries will address the Colloquium on a wide range of topics spanning the interests of both fields. A selection of topics to be discussed include the following.

- Automotive Manufacture/Electronics Supplier Interface
- Making Semiconductor Sensors Production Worthy
- Implementation of Car Central Computer Systems
- Status of Automotive Electronics in Japan and Europe
- Applications of Electronics to Fuel Management and Emissions Systems
- Reliability Assessment of Automotive Electronics
- State-of-the-Art Transducers and Displays
- Solid-State Micro-Processors

Speakers will come from USA, Japan, Italy, Germany, and England.

Additional program information may be obtained from SAE, Inc., 18121 E. Eight Mile Road, East Detroit, Michigan 48021; telephone (313) 733-0700.

THE WASHINGTON SCENE

BY ERIC SCHIMMEL

HAZARDOUS RADIATION?

"Indiscriminate use of this product may be injurious to your health." No, this hypothetical warning does not refer to the use of tobacco, vinyl chloride, or any other organic or chemical substance. It may, in the not too distant future, however, become a commonplace caveat in the radio telecommunications industry. To be specific, there is more than a marginal interest by the Federal Government in the possible biological effects of exposure to electromagnetic radiation. In fact, an ongoing multi-agency research effort has been programed with a $63 million five-year budget.

I broach this subject with you, not to create an atmosphere of impending crisis, but rather to alert radio users and manufacturers to a developing situation which, in my opinion, has not received adequate industry attention. As consumers, we have all heard commentaries about the danger of X-ray exposure (ionizing radiation) from color TV sets, and leakage from microwave ovens (non-ionizing radiation). In both of these cases considerable publicity arose from the consumer related concerns, but examination of industrial implications has been limited almost entirely to highly technical scientific journals. It is apparent that due either to a lack of awareness or astuteness, industry's posture has been relatively passive until a government agency releases a notice of its intent to issue new standards and regulations. Then there is a scramble to attempt to limit regulations which should best have been developed with early industry involvement.

In the two product examples noted thus far, regulations have been introduced by OSHA, HEW (Bureau of Radiological Health), and the FCC. By the admission of almost all concerned, the regulations which have been adopted are largely arbitrary, with substantial disagreement among scientists as to what the appropriate technical standards should be. This is not to say that the present union regulations are ultra conservative. Comparable standards in the Soviet, for example, are much more stringent, and there is a strong possibility that the EPA will press for adoption of similar standards. The truth of the matter is, that there is still inadequate research data with which to develop conclusive standards for exposure levels.

The complexity of the problem is enormous. If we limit ourselves to the area of non-ionizing radiation, such as is associated with all types of radio, television, microwave, radar, etc., transmitters, we have a vast frequency range to investigate. While there is strong evidence that consistent exposure to microwave radiation may cause

ocular cataracts in humans, there is only speculation that this is not a practical problem in lower frequency ranges. Then there is the paramount problem of measurement technique. One reason that discrepancies exist between Soviet and American standards is that little is known about how the Soviets conduct their measurements. A recent trip to the Soviet Union by a team of U.S. scientists has helped to resolve some of these questions. Little fault was found with the Soviet experiments as far as they go, but a general observation was that they are substantially less sophisticated than ours.

Several special measuring probes have been developed, including one by the National Bureau of Standards. Since the ultimate goal is to establish safe levels of exposure for human tissue and organs, some scientists feel that final experimentation must be made with implanted probes. Some such experiments with animals have raised serious problems with measurement technique. For example, measurements made with external probes near a dog's eye, produced substantially different results than with a probe placed in the eye socket itself. These "near field" measurements are extremely sensitive because of the low signal levels being measured, and extreme care must be taken to eliminate any distortions due to the physical nature of the probe. In the case just cited, one possible explanation for the difference in measurements is that the dimensions of the eye socket produced a resonance at the radiated frequency. This raises the question of potential resonances in various other internal organs, but conclusive experimentation on humans will be difficult to conduct.

By now, it should be apparent that this subject poses a unique problem; that of being able to communicate with scientists of another discipline. Electronics specialists attending current symposiums on radiation are finding that biological terminology predominates the presentations, and even that questions and comments from the floor are highly medical. This calls for a lot of engineers to learn a lot of new words. More importantly from my point of view, however, is the need for engineers to work with the biologists and physicians, to assure that their research is not devoid of the real world considerations of product applications. I am not implying any lack of confidence in the competence of the researchers, but I think the industry should be watchful of unwitting witch hunts. Perhaps a couple of examples are in order.

Most of the concerns with non-ionizing radiation relate to the internal heating which it can generate in living tissue. One interesting experiment has shown that enzymes, which control important body functions, can be damaged by heat,

regardless of whether the heat was introduced thermally or electromagnetically. Approximately a year ago OSHA proposed standards with specific application to limiting physiological heat stress in persons working in microwave environments. One proposed way to meet the standards involved wearing special protective clothing, It was found, however, that a metalized jacket or suit would arc in the presence of typical microwave fields and had to be insulated with neoprene. Ironically, comments submitted in that proceeding pointed out that at temperatures above 70° F, wearing such clothing would cause greater heat stress than could possibly be caused by the radiation against which it was to be protective. Needless to say, the proposal has not been adopted.

Other examples stressing the need for scientific teamwork involved the irradiation of animals in environments totally unsuited for the purpose of the tests. In one case, the tests and measurements were made with the animals in metal cages. The probable distortions in the data due to the metal has apparently been totally disregarded by the researcher. In another reported case, a dog was irradiated in a chamber which literally cooked it. We don't know what this proved, other than that microwave ovens work, but the revelation made electrical engineers shudder.

For those of you in whom I may have generated a desire to dig a little deeper into this subject, I suggest obtaining a copy of the second annual report of the Electromagnetic Radiation Advisory Council, published by the Office of Telecommunications Policy. OTP's address is 1800 G Street, N.W., Washington, D.C. 20006.

ERMAC consists of nine non-government scientists, and is chaired by OTP. It was organized in 1968 and developed the recommendation for the current multiagency program which is scheduled through fiscal 1978. While its influence is primarily advisory, in overseeing the entire program, OTP attempts to guide the individual agencies away from duplication of effort and encourages application of resources to produce as broad a base of research as possible. It also serves as an interface between agencies and attempts to moderate differences in policy and philosophy, which I assure you exist.

As concluding remarks, I want to re-emphasize concern for more direct industry involvement in this program. In light of some awards which have been made in civil suits charging responsibility for cataract development, a head-in-the-sand posture would seem to be unwise. Apathy as an excuse for heretofore inaction is equally unsatisfactory, notwithstanding that recent psychological research has identified the development of lethargy in rats exposed to radio fields. Clearly, the government's investigations will continue. It is even possible that some beneficial side effects will evolve. But I think the question we must ask ourselves today is, who's watching the store for my company?

1974 MICROWAVE MOBILE COMMUNICATIONS SYMPOSIUM A GREAT SUCCESS

BY: SANG RHEE

The third annual Symposium on Microwave Mobile Communications was successfully conducted from September 11 through 13 at the Department of Commerce Laboratories in Boulder, Colorado. The three day symposium was sponsored jointly by the IEEE Vehicular Technology Group, Communications Society, Denver Section, and the Office of Telecommunications, Institute of Telecommunications Sciences of the U.S. Department of Commerce. A total of 24 technical papers were presented in four separate sessions. Over 130 people representing 39 different organizations in the United States, Canada, and England participated in this year's symposium. This year's attendance increased by approximately 20% over last year's and was the largest among the three meetings held in Boulder since 1972.

The Microwave Mobile Communications Symposium was originally organized in 1972 to provide an informal forum in which working level engineers and scientists actively engaged in the mobile communications fields could meet to exchange up-to-date information on current work in progress. Particular emphasis was placed on the papers dealing with frequencies above 800 MHz in the then anticipated release of FCC Docket 18262, allocating the 800-900 MHz band for use in mobile communications. To encourage participants to share partial results of work still in progress and to minimize the time associated with manuscript preparation, the Boulder symposium was organized to be much more informal than is conventional for technical conferences and symposia. As such, the Symposium each year distributes only a list of abstracts to the participants, and the authors are encouraged to submit their complete papers to appropriate technical journals, such as the IEEE Transactions on Vehicular Technology or the IEEE Transactions on Communications, for more formal documentation.

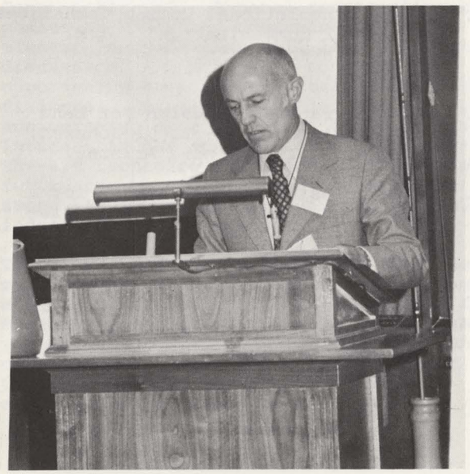
In the first session of this year's symposium, Dr. William Jakes, Jr. of Bell Laboratories, the invited speaker, gave a comprehensive review of the work done by researchers in the mobile communications field during the past decade, illustrating how order was brought about from the chaotic nature of the mobile transmission medium. This year's meeting coincided with the 20th anniversary of the Department of Commerce Laboratories in Boulder. The Boulder Laboratories open house activities were included as part of the Symposium program making this year's meeting more exciting and interesting to our participants. In addition to interesting visits to a number of Department of Commerce Laboratories, many of our symposium attendees heard Professor Charles Susskind of the University of California give a very interesting talk on the early history of radio communications, commemorating the Marconi centennial. Thursday's banquet was attended by more than 70 people. The highlight of the evening was a talk by Professor Petr Beckmann of the University of Colorado entitled "Language as an Error-Correcting Code". Professor Beckman provided insight on the many interesting features of different languages where numerous redundencies are built into the languages to prevent misunderstandings.

No definite plans were made for future symposia. However, from the growing interest shown by the steady increase in the number of participants over the past three years, a fourth symposium will undoubtedly be scheduled for the next year. The recent FCC allocation of the 800-900 MHz band for mobile communications will certainly intensify interest in this area as activities in the mobile radio industry accelerates. Those who could not personally attend the meeting this year but are interested in obtaining a list of abstracts are encouraged to contact either A.P. Barsis of the Department of Commerce Laboratories, Boulder, Colorado 80302 or S.B. Rhee of Bell Laboratories, Whippany, N.J. 07981.

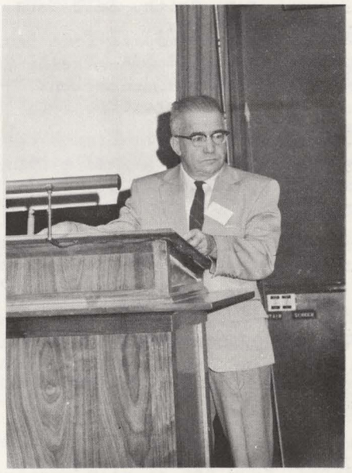
ACTIVITIES AT THE SYMPOSIUM

Scene at the registration desk

Mr. Crombie, Director of the Institute of Telecommunications Sciences, giving a welcoming word.



Dr. William Jakes Jr., of Bell Labs, the invited speaker, giving the first paper of the symposium.



Mr. A. P. Barsis of the Institute for Telecommunications Sciences, Propagation Session Chairman, introducing a speaker.

SYMPOSIUM PAPERS

SESSION I - PROPOGATION
Session chairman--A.P. Barsis, OT/ITS Boulder, Colorado

1. "Bringing Order Out of Chaos - A Decade of Progress in Mobile Radio Research" - W. C. Jakes, Jr., Bell Labs., North Andover, Mass.

2. "Limits on Correlation Coefficients and Their Effects on Radio Propagation Measurements" - P. Onno, Bell Labs., Whippany, N.J.

3. "Results of Extended Range Propagation Measurements at 820 MHz in Suburban Area" - K.K. Kelly, II, Bell Labs., Whippany, N.J.

4. "Postscripts to 900 and 450 MHz Mobile Radio Performance in Urban Hilly Terrain'" - F. A. Barton, and G.A. Wagner, RCA, Meadowland, Pa.

5. "Reflections, Diffraction, and Veriability of Signals at 900 MHz" - N.H. Shepherd, General Electric Co., Lynchburg, Virginia.

6. "The Attenuation of UHF by Buildings" - P. I. Wells, OT/ITS, Boulder, Colo.

7. "60 GHz Mobile Radio Propagation Experiment" - H. W. Arnold, and H.H. Hoffman, Bell Labs., Holmdel, N.J.

SESSION II - SIGNALING, CONTROL, AND DATA/ VOICE TRANSMISSION

Session chairman--J. Mikulski, Motorola, Inc. Schaumburg,Ill.

1. "Data Signaling Functions for a Cellular Mobile Telephone System" - V. Hachenburg, B. D. Holm, J.I. Smith, Bell Labs., Naperville, Illinois.

2. "A New Digital Data Transmission System for Mobile Radio Communications" - J. En, and D. Brown, Motorola, Inc. Schaumburg, Illinois.

3. "Word Error Rates in a Fading Channel at 850 MHz" - J. I. Smith, Bell Labs., Whippany, N.J.

4. "An Analysis of Errors in Data Transmission at 900 MHz" - J. W. Noerenberg, J. H. Sangster, and J. Pautler, Motorola Inc., Schaumburg, Illinois.

5. "On the Random-FM-Limited Performance of Data and Voice Transmission in Mobile Radio" - G.A. Arrendondo, Bell Labs., Holmdel, N.J.

6. "Land Transmission Planning in Cellular Mobile Telecommunications System" - L. W. Hansen, Bell Labs., Holmdel, N.J.

7. "Vehicle Locating by the Phase Ranging Technique" - K. L. Steigerwalt, Bell Labs., Whippany, N.J.

SESSION III - U.S. DEPARTMENT OF COMMERCE LABORATORIES 20th ANNIVERSARY OPEN HOUSE ACTIVITIES

SESSION IV - SYSTEM CONCEPTS, NOISE AND INTERFERENCE

Session chairman--R. Ennis, Martin-Marietta, Rumson, N.J.

1. "Emergency Medical Service Communications" - J.A. Hull, OT/ITS, Boulder, Colorado.

2. "Hi-Com, Advanced Mobile Telephone System" - A.J. Malinger, Martin-Marietta Aerospace, Orlando, Fla.

3. "Statistical-Physical Model of Man-Made Radio Noise" - D. Middleton, and A. D. Spaulding, OT/ITS, Boulder, Colorado.

4. "Dedicated Instrumentation for Servicing 900 MHz Band Mobile Radios" - C. A. Sorensen, Singer Instrumentation, Los Angeles, California.

5. "Correlated Fading, Unequal Branch Gains, and Other Aspects of Predetection Diversity Combining" - S.W. Halpern, Bell Labs., Holmdel, New Jersey.

6. "Marconi Centennial-Early History of Radio Communications" - C. Susskind, University of California, Berkley, California.

SESSION V - COMPONENTS, DEVICES AND CIRCUIT DESIGN

Session chairman--D.C. Cox, Bell Labs., Holmdel, N.J.

1. "Robust Convolutional Coding Techniques for Digital Communication" - I.M. Jacobs, Linkabit Corp., San Diego, California.

2. "900 MHz Transistor Design for Land Mobile Application" - R. J. Johnsen, Motorola, Inc., Phoenix, Arizona.

3. "Product Design Considerations for a 25 Watt, 12.5 Volt, 900 MHz Transistor" - R. Potyka, Motorola, Inc., Phoenix, Arizona.

4. "Determination of Filter Requirements for a High Capacity Mobile Telecommunications System Base Station" - A. K. Johnson, Bell Labs., Whippany, New Jersey.

5. "Design Considerations of a Base Station Antenna Tower" - F. V. Gates, Bell Labs., Whippany, New Jersey.

THE 25TH ANNUAL VTG CONFERENCE

A WELCOME MAT GOES OUT

BY: ART DINNIN

The 25th annual VTG Conference, scheduled for January 21-22, 1975 in Toronto, promises to be one of the most attractive ever held. It might even surpass the success of the first one held in Canada in Montreal in December, 1966. The VTG conference committee is preparing an outstanding program and will have a large welcome mat ready for your use.

There will be four main attractions:

1. The technical papers. The quality of papers submitted to date meets all expectations. Authors from England, Japan, and Canada combine with those from the United States to bring you the very best and latest in the traditional fields of spectrum management, propagation, system design, and automotive electronics.

2. The exhibits. Your favorite manufacturers and suppliers have already contracted for space to display their latest and their best.

3. The highlight. A seminar session in which the theme will be "The Future in Vehicular Communications". A panel representing key phases of vehicular communication and electronic technology will lead an "open discussion" and will give conferees an opportunity to personally take part in the dialogue. On the occasion of our silver anniversary, at a time when there is great interest in the application of state-of-the-art technology, contemplation of the future can be exciting and a discussion among knowledgeable participants can be, indeed, a rewarding experience.

4. The city. Toronto in winter is still very much alive. It offers theatre, shopping and sight-seeing, enough in themselves to make a visit a great pleasure. For example you can see the world's tallest tower under construction, visit the Ontario Science Center, view the unique City Hall architecture or tour the night-spots.

A few of the papers proposed for technical sessions are listed: -

"A Double Phase Sweeping System for Diversity Reception in Mobile Radio", A.J. Rogers, Central Electricity Research Lab., Leatherhead Surrey, England.

"Automatic Vehicle Monitoring Optimized For Multi-User Economics", Dr. George Gruver, Information Identification Inc., Fort Worth, Texas.

"Design for System Reliability in Personal Radio Signalling", George P. Schleicher, Illinois Bell, Chicago, Illinois.

"Automated Maritime Mobile Radio Telephone System", Masanobu Watanabe, Nippin Telegraph and Telephone, Japan.

"Measures of Spectral Efficiency in Land Mobile Radio", Dale N. Hatfield, U.S. Dept. of Commerce, Boulder, Colorado.

"Thick Film/Flip Chip/System Approach", Randolph C. Early, General Electric Co., Lynchburg, Virginia.

"Statistical Analysis of Communications Range and Reliability in the Presence of Interference", Leon Jasinski, Motorola, Inc. Ft. Launderdale, Florida.

"System Considerations in the Design of a Metropolitan Paging System", David F. Willard and Ronald E. Sharp, Motorola, Inc., Ft. Lauderdale, Florida.

"New York City Central Control for Radio Dispatching", H. Bloomberg, New York, New York.

"A Comparison of Two Efficient Digital Modulation Systems", Dr. R. E. Debuda, Canadian General Electric, Toronto, Ontario, Canada.

"Selectivity Measurements in the Production and Maintenance of Mobile Communications Receivers", J. Everett McTaggart, Singer Corporation, California.

"Mobile Antenna Gain at 900 MHz", Allan Davidson, Motorola, Inc., Schaumberg, Ill.

Additional papers are expected, some of which will be concerned with automotive electronics.

TORONTO-
THE TOMORROW CITY

Toronto today is a city growing at a fantastic rate, bursting with energy, living it up.

It's the site of a 15-year, one billion dollar project to build a city-within-a-city- the largest single urban development program in North America --- Metro Center.

It's built itself a multi-media exhibition center 100 feet over the water of Lake Ontario, and a bank that's 57 stories high.

It's building itself the tallest free-standing structure in the world -- the 1,805 foot CN Tower -- complete with communications center and revolving restaurant.

Toronto has an arts center that dramatizes e every interest of the public; it has a museum where the signs say "please touch".

And to string it all together, the city has a modern subway system that's getting longer every day. Not bad for a place that used to be called Hogtown.

Metro Center will do for Toronto what most North American cities are only dreaming of as yet; completely revitalize the core of the city. Strategically situated between Toronto's central business and financial district and the Lake Ontario waterfront, the Metro Center development will cover 190 acres.

The project has four major elements; a transportation complex, a communications and broadcasting center, a commercial-office area, and a residential sector with downtown living for 20,000 people. Metro Center will be Canada's largest communication and broadcasting center, featuring a soaring 1,805-foot tower with spectacular observation, dining, and broadcasting areas at the 1,200-foot level.

The Metro Center concept - totally integrated urban living - is a major step in humanizing the downtown environment of what is potentially one of the world's greatest urban communities. The first stage will be complete by 1973.

LAKEFRONT DEVELOPMENT

Dwarfed by the massive Metro Center, but just as significant in its own way, is nearby Ontario Place, an exciting new world on three man-made islands offshore in Lake Ontario.

The complex consists of a graceful five-part pavilion set on 100-foot columns rising from the lake. Two newly-created islands, a triodetic dome theatre called Cinesphere, and beautifully landscaped parks, are included in this project. The site covers some 93 acres, and is connected to the mainland by a two-tiered, enclosed walk 35 feet above water.

Inside the pavilions the story of Ontario is told in a total-involvement multi-media exhibition. Cinesphere is the most technically advanced theatre in the world, able to show experimental films of every kind.

An ultra-modern marina with complete facilities for 350 boats, a variety of unique indoor and outdoor restaurants, and a 6,000-seat forum are among the other features at Ontario Place.

The Ontario government project, opened in May 1971, is expected to be a catalyst -- a physical starting point for new Toronto waterfront developments.

Commerce Court is another important piece of recent construction. The four-tower complex built by the Canadian Imperial Bank of Commerce includes a 57-story headquarters building opened in 1972.

Commerce Court is planned as a self-contained business community with shops, restaurants, and communication, and banking facilities. More than 30 stores and a full range of dining rooms and cocktail lounges will be included in the adventuresome project.

Over 2 1/2 acres of sheltered courtyard will provide a pleasant place where Torontonians can sit in the sun and relax -- an oasis of calm in the heart of the central business area.

ST. LAWRENCE CENTER FOR THE ARTS

Toronto, a great business and financial metropolis, is also the cultural center of English-speaking Canada. The new burst of construction activity has not neglected the soul. The St. Lawrence Center for the Arts, opened in February 1970, is designed as a focal point, a center of gravity, for the expression of the arts.

The Center's 830-seat repertory theatre has been designed for the utmost flexibility, permitting proscenium, thrust, and caliper stages. It houses its own resident theatre company.

A 480-seat "town hall" is included in the center which is used as a small concert hall and for a wide variety of public affairs programming -- films, forums, teach-ins, lectures, demonstrations, mixed media, folk arts -- a meeting place for all the community and all its interests. Underground film festivals, nostalgia nights, variety shows, a rock concert series, poetry readings, and public affairs teach-ins are planned for this season.

SCIENCE CENTER

"Please touch" is the motto of a unique museum in the heart of Metropolitan Toronto called the Ontario Science Center. Opened near the end of 1969, the Center features more than 450 participational exhibits that emphasize the present and the future of science and technology, rather than the past. New exhibits will be added and others updated to keep pace with man's scientific achievements. The idea is to communicate to visitors of all ages and backgrounds a better understanding of how science and technology affect their lives.

Get ready for a trip into the furthest corners of man's mind. Prepare to participate. It is all displayed in simple graphic form made easy -- and exciting -- by the flick of a switch, or the press of a button. Twelve main exhibit areas include space, earth and molecular sciences, engineering, communications transportation. life sciences, Canadian resources, spaceship earth, world of the atom, hall of life and a swinging "Science Arcade".

A working weather station, air pollution monitoring post, glass-blowing laboratory, offset printing shop, electron microscope, and a power amateur radio station are all there -- all fully operational and entirely touchable.

The Ontario Science Center is open every day but Christmas. Tues. - Sun. 10:00 a.m. - 10:00 p.m.; Monday 10:00 a.m. - 6:00 p.m. Because it is so vast and interesting it is better to plan it in 2 1/2 hour shifts, rather than one all-day visit.

Toronto built Canada's first subway and it is still one of the finest in the world. It has just been extended making it over 23.4 miles long with forty-seven stations --- one of the largest in the world. The revitalization of the city core and ever-increasing population of the suburbs means that further extensions are required to the Yonge Street System. An additional 2.8 miles and two stations is scheduled for completion in the spring of 1974. Because of the vast efficient transportation system, it is usually simpler to leave the car at home or tuck it into a parking lot when you visit Toronto and take the public transportation system.

There's action all around in Toronto. The city is being reborn in skyscraping towers, 12-land freeways, first-class public transit, and thousands of acres of magnificent green parkland.

It's the city of the citizen --- Toronto.

PHOTO CREDIT
Convention and Tourist Bureau of Metropolitan Toronto

A GLIMPSE AT THE ADCOM ELECTIVE PROCESS

BY: BOB BLOOR

About the time you receive this copy of the VTG Newsletter, you will be receiving a ballot for 5 openings on the ADCOM (Administrative Committee). This note is to give you, the member, some idea how people "Get in ADCOM" and the requirements for participation.

First - All of the affairs of our Group are under the supervision of a group of 15 persons who constitute the Administrative Committee (ADCOM). Each member of ADCOM is elected by the membership for a three year term, five members each year. All terms start January 1, following the election and end December 31 three years later. During the first ADCOM meeting each year, the ADCOM elects a Chairman, Vice-Chairman, and Treasurer out of these 15 members. The Chairman appoints a Secretary, who need not be an elected member of ADCOM. The three elected officers, the Secretary, and the two past Chairmen constitute the Executive Committee, which is an advisory body to the Chairman. The Chairman appoints all Standing and Ad Hoc Committees, and represents the Group membership whenever and wherever required. All elected and appointed members of ADCOM and its committee carry out all of their functions at no expense to the membership. These expenses, which usually are travel expense and secretarial support, are generally covered by the member's employer.

One of the appointments made by the Chairman is the "Nominating Committee". This committee consists of at least five persons with less than 50% of the committee being elected members of ADCOM. The responsibility of this committee is to provide a slate of at least ten nominees for election to the next years ADCOM. The committee arranges to obtain candidates for nomination using names of persons offering to serve, personal contacts, Group Chapter Officers, mailing to the membership, etc. The committee screens the candidates and assembles the details of information necessary for the election process.

The entire election process, which starts sometime in March, and ends with IEEE Headquarters counting the ballots, takes about eight months. A great deal of work goes into the process, both by the committee and by the nominees. Everyone concerned takes this work seriously as the health and welfare of the Group Organization depends on the ADCOM.

Any member of the VTG is eligible to be a candidate for nomination to the ADCOM. Any member willing to serve can submit his name to the "Nominating Committee Chairman" during March. Any member can submit the name of any other member as a candidate providing the candidate agrees to having his name submitted. Any member whose name has been submitted by 25 or more members automatically becomes a nominee providing he agrees and will be able to fulfill his responsibility.

You, the member, should carefully consider all nominees and vote for the persons of your choice. Your vote not only elects members to the ADCOM, but is also a vote of thanks to all persons who serve the VTG membership. All of us are busy and these people are just a little busier than most.

THE UNWANTED-- KNOWN ALSO AS "SPURS"

BY: A.K. "KENNY" GUTHRIE

In two-way radio, we have only two major technical problem classifications:
(1) People don't hear what they want, or
(2) People hear what they don't want!
We bit off a hunk of Category #2 with the review of intermodulation interference in the last issue, and continue in the same vein with this article.

We can classify the interference mechanisms which keep us in business into these groups:

CO-CHANNEL. The normal output frequency of a transmitter is the normal input frequency of a receiver.

TRANSMITTER SPURIOUS (output). A transmitter output frequency, other than the normal output, is the normal input frequency of a receiver.

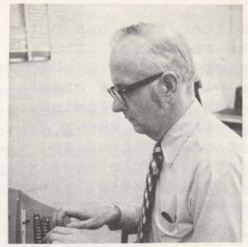
RECEIVER SPURIOUS (response). The normal output frequency of a transmitter enters a receiver at a frequency other than the receiver's normal input.

INTERMODULATION. Two or more signals combine in a non-linearity to produce a product frequency which is the normal input frequency to a receiver.

CO-CHANNEL interference (see Figure 1) is the ultimate limit on interference-free system operation. Nothing except space isolates the transmitter from the distant receiver. For the 100 watt transmitter shown in the example, and the 0.5 uV receiver, you will deliver a useful signal to the receiver unless transmission loss is 163 dB or more. In our high band, for example, this translates to a respectable distance: 25-35 miles for base-mobile situations; 50-70 miles for base-to-base paths, and a few thousand miles if your "mobile" happens to be in outer space!

TRANSMITTER SPURIOUS OUTPUTS appear on frequencies predictably removed from the transmitter's normal operating frequency. We will examine the frequency relationships later. For now, look at the power picture. See Figure 2. One of the challenges of transmitter design is to minimize the levels of the inevitable spurious outputs. Spurious output specifications, typically from -60 dB to -85 dB, show the power level of the strongest spurious output in dB below the transmitter carrier power. In the United States, FCC requires that the worst spurious be suppressed by at least:

$$dB = 43 + 10 \log_{10} \text{Power Output.}$$



For any transmitter power output, the power, less the required suppression, works out to an absolute power level of -43 dBW. This is the highest spurious power you should expect any transmitter to deliver under normal circumstances.

With 60 dB of spurious suppression, or more, guaranteed as part of the transmitter design, the "circle of influence" of transmitter spurious outputs, though substantial is much less than that from co-channel interference. To get below the "usable" level, our example shows that we need 100dB of loss between the transmitter, which produces the spurious output, and the receiver which responds to it. At high-band, a mobile reaches this loss at about 2 miles from a typical base station. For typical base-to-base paths, you're dealing with distances around 10 miles. If you're afflicted with a spurious output from an unidentified transmitter, you should look for it within these circles. If you identify an interfering transmitter, and it's located beyond these distances, there's a good chance that the interference mechanism is NOT a transmitter spurious output.

RECEIVER SPURIOUS RESPONSES (See Figure 3) also display a predictable frequency relationship to the receiver's operating frequency. More about this later. Again, minimization of the effect of the inevitable spurious responses is a major design challenge. How well this challenge is met is indicated, in part, by the receiver's spurious response specification. The specification shows the degree to which the receiver is responsive at the frequency of its worst spurious response. Specifications of 85 dB to 100 dB are typical now. A specification of 100 dB means that a signal at the frequency of a spurious response must be at least 100 dB higher than the receiver's 12 dB SINAD sensitivity to produce 12 dB SINAD output. With 100 dB spurious rejection, you need search only a very small circle to find the transmitter which may enter your receiver via a spurious response. Loss amounting to 63 dB between transmitter and receiver will drop the "spur" below usable level. At high-band, the radius of vulnerability is only about 0.2 miles. If an interfering signal originates several miles away, and you have a modern (100 dB) receiver, look for explanations other than receiver spurs.

DOUBLE SPURIOUS--transmitter spurious output to receiver spurious response. The state of the art has outgrown this problem! See Figure 4. Starting with "worst case" spurious output at -43 dBW, and allowing for 100 dB spurious rejection in the receiver, you must connect transmitter to receiver with coax to get a usable receiver output! This being an unlikely system operating mode, we move to matters more productive.

A PLUG FOR THE ELECTRONIC CALCULATOR PEOPLE

If you are going to do interference analysis, whether by intent or default, get yourself an electronic calculator. There are dozens of versions on the market; each has its good and bad points. Look for these features as a minimum: (1) 8 or more significant figures displayed, (2) floating decimal, and (3) multiplication by a constant. A memory is certainly handy. Beyound this, you're on your own. Get the extra keys which capture your imagination or will impress your peers. With a pocket calculator, some pre-programming, and some experience, you can get to the bottom of many problems while someone else is negotiating a connection to a time-share computer! Save the big guns for the big problems.

TRANSMITTER SPURIOUS OUTPUT FREQUENCIES

The frequency of every transmitter spurious output is a whole-number multiple of the transmitter's oscillator frequency. This makes it quite easy to predict the frequencies where a troublesome spurious output may appear. See Figure 5.

Part A shows a typical transmitter, which includes an oscillator, a string of frequency multipliers, and a power output circuit. The oscillator frequency is the output frequency, divided by the total multiplication, m.

Part B shows a transmitter in which the total multiplication is 12, distributed through three stages as X2, X3 and X2. Output is at 155.13 MHz. The spurious outputs arise because the multiplying stages are non-linear, as they must be, and because the filters are imperfect. The first multiplier, a, is supposed to double, but it also has some output "straight through." It has output, also, at the third and higher harmonics. The second multiplier, intended to triple, has output "straight through" and at other multiples. Likewise, the third multiplier. There can be an output from any multiplier stage at any multiple of its input drive. The transmitter designer attempts to minimize the number and level of these undesired products. If a = b = c = 1, you have a spurious output at the oscillator frequency. If a = 2, b = 1 and c = 1, an output can appear at twice the oscillator frequency. The machinery is there to develop outputs across the entire spectrum, from the oscillator frequency, up.

Part C of Figure 5 shows the pattern. The potential spurious outputs extend both above and below the operating frequency, at intervals equal to the operating frequency.

The Calculation Procedure in Figure 6 lets you predict where transmitter spurious outputs may fall. You can confirm transmitter "spurs" as a potential experience for a "real life" interference problem. Knowing the spurious output to be real, you can then set about to measure its level as a prelude to engineering the required corrective action. The corrective action, by the way, usually requires you to add selectivity at the transmitter output, to keep troublesome spurious outputs from passing to the antenna system.

Transmitter Harmonic Outputs are a special case of transmitter spurious outputs. These are the "spurs" with frequencies which are a whole-number multiple of the transmitter output frequency. They are, obviously, also related to the transmitter oscillator frequency. Rather than calculate the harmonics separately, it makes more sense to extend the multipliers used in the Figure 6 procedure upward to include the harmonic frequencies of interest. This identifies the harmonics, and identifies nearby spurious outputs, as well.

In the example which is part ofFigure 6, we calculate and display only the potential spurious outputs which fall in one of our major bands.

Modulation deviation of the spurious output varies directly with the multiplier from the oscillator frequency. The modulation of the spurious output which is 11/12 of the operating frequency will be 11/12 of the modulation at the operating frequency. This will appear "normal" to the observer. However, modulation on the "spur" which is 36/12 of the operating frequency (the third harmonic, in other words) will be three times "normal" modulation. Grossly over-deviated signals should make you suspect a harmonic or high-multiple spurious output from a transmitter.

RECEIVER SPURIOUS RESPONSES

A receiver, such as shown in Figure 7, will respond when two signals with frequency separation equal to the IF frequency appear in the mixer. If both signals come from sources external to the receiver, we're dealing with intermod, the subject of an earlier article. We deal here with single-frequency responses, in which one of the inputs to the mixer is provided by the injection chain. We conveniently ignore the responses contributed by the second mixer (if any).

The injection frequency, of course, is directly related to the operating frequency. The injection frequency is set one IF frequency away from the operating frequency, usually--but not always--on the low side.

The frequencies of the spurious responses are related directly to the injection frequency (including those undesired multiples of the oscillator frequency which appear at the injection chain output). Just as with transmitter spurious outputs, one can't generalize concerning the levels of the various spurious responses. Once the existence of a specific spurious response is confirmed by calculation, its magnitude can be measured, easily, with a signal generator. You may need a high-output generator, because more than a few of the spurious responses are "way down."

In Figure 7, you'll find the block diagram of a typical receiver front end, and two of the spurious mechanisms you are likely to encounter. The two aren't really different...they ultimately reduce to the same thing. Both reflect a basic truth--when two signals, separated by the IF frequency, get into the receiver--you have a response!

Section A focuses upon multiples of the oscillator frequency which, being fairly close to the injection frequency, find their way to the output of the injection string. A signal, spaced one IF away from any of them can, levels permitting, produce a response. The worst ones are usually those closest to the injection frequency (m ± 1), and it's smart to look for them first.

Figure 8 is a "program" for using your pocket calculator to quickly compute these potential spurious response frequencies. If your calculator has a memory, you can put it to good use by storing the oscillator frequency as you start Step 7. As you see, you need use only a few multipliers to cover a specific one of our bands. Subtracting twice the IF frequency is a shortcut to minimize operations when using a "low grade" machine!

Part B of Figure 7 zeros-in upon high level effects. The high-level injection can create multiples of the injection in the nonlinear mixer. We determine the frequencies which are one IF on either side of an injection multiple and divide them by whole numbers to identify the potential spurious responses.

Part 9 is the detailed calculation "program" which goes with Part B of Figure 7. You may find the sample calculation (Figure 10) easier to follow. In Figure 10, we show only the responses which fall within our main bands, and limit N to a value of 10. Although not identified as such, the traditional "worst case" responses all appear in the table. The "image"--144.53 MHz--shows up when M = 1 and N = 1, in the subtractive column. The two "half-IF" spurs are found when M = N = 2.

There are other response possibilities, of course. You may encounter a high multiple of the oscillator which is not also a multiple of the injection frequency. You can run these out, if you have the ambition, by using the "program" detailed in Figure 9. Substitute the oscillator frequency for the injection frequency at Step 3, and use appropriately high multipliers at Step 4.

Happy hunting, and keep your calculator's battery at full charge!

#####

CO-CHANNEL

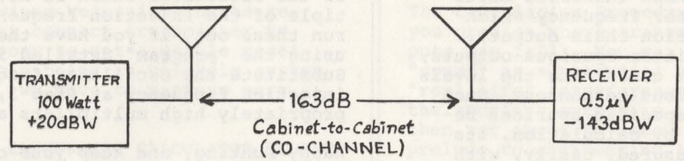


Figure 1

TRANSMITTER SPURIOUS (OUTPUT)

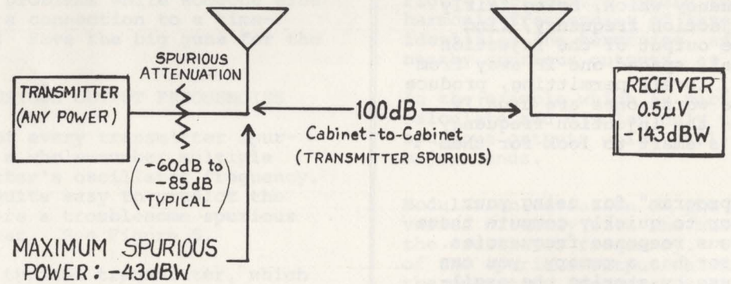


Figure 2

RECEIVER SPURIOUS (RESPONSE)

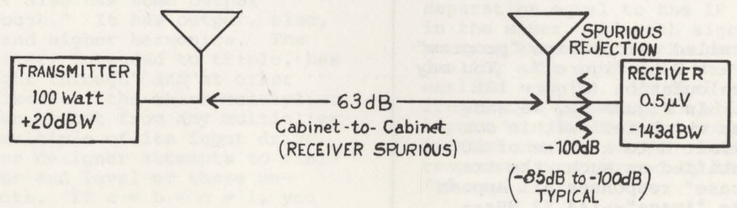


Figure 3

TRANSMITTER SPURIOUS (OUTPUT)
TO
RECEIVER SPURIOUS (RESPONSE)

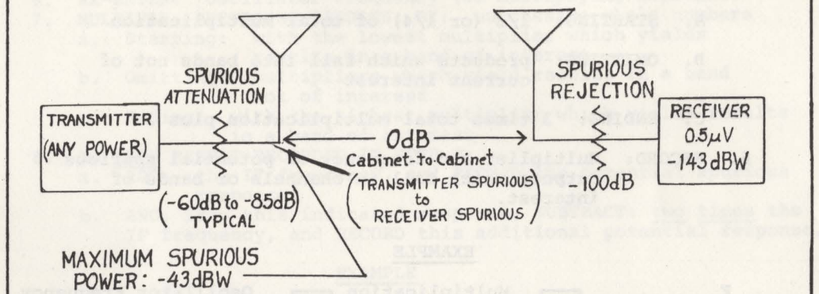


Figure 4

TRANSMITTER SPURIOUS OUTPUTS (FREQUENCIES)

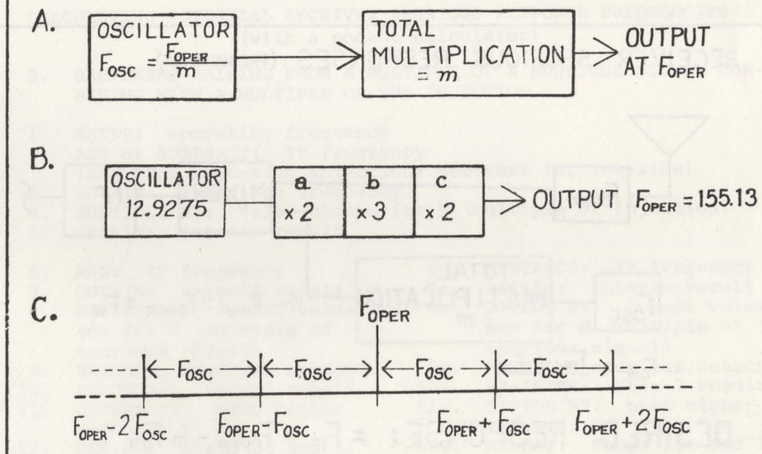


Figure 5

CALCULATING POTENTIAL TRANSMITTER SPURIOUS OUTPUT FREQUENCIES
(with a pocket calculator)

1. ENTER: operating frequency
2. DIVIDE BY: total multiplication
3. OBTAIN: oscillator frequency
4. RE-ENTER: oscillator frequency (as multiplying constant)
5. MULTIPLY BY SUCCESSIVE WHOLE NUMBERS
   - A. STARTING: 1/3 (or 1/4) of total multiplication
   - B. OMITTING: products which fall into bands not of current interest
   - C. ENDING: 3 times total multiplication plus 2
6. RECORD: Multiplier and frequency of potential spurious outputs which fall in channels or bands of interest.

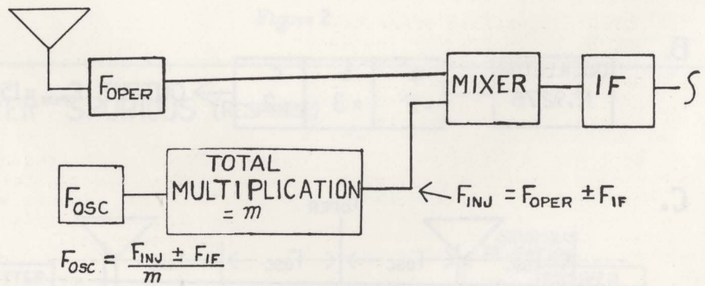
EXAMPLE

$F_{operating}$	÷	Multiplication	=	Oscillator Frequency
155.13		12		12.9275

Oscillator Freq	X	n	=	Spurious Output Frequency
12.9275		2		25.8550
		3		38.7825
		13		168.0575
		35		452.4625
		36		465.3900
		37		478.3175

Figure 6

RECEIVER SPURIOUS RESPONSES (FREQUENCIES)



DESIRED RESPONSE: $\pm F_{IF} = F_{OPER} - m F_{OSC}$

TWO SPURIOUS RESPONSE MECHANISMS:

A. $\pm F_{IF} = F_{SPUR} - N(F_{OSC})$

B. $\pm F_{IF} = N(F_{SPUR}) - M(F_{INJ})$; WHERE M AND N ARE WHOLE NUMBERS

Figure 7

CALCULATING POTENTIAL RECEIVER SPURIOUS RESPONSE FREQUENCIES
(with a pocket calculator)

A. RESPONSES ARISING FROM UNDESIRED MULTIPLES OF THE OSCILLATOR IN THE INJECTION CHAIN OUTPUT

1. ENTER: operating frequency
2. ADD OR SUBTRACT: IF frequency
   (add, for high-side injection; subtract for low-side)
3. OBTAIN: injection frequency
4. DIVIDE BY: total multiplication
5. OBTAIN: oscillator frequency
6. RE-ENTER: oscillator frequency (as multiplying constant)
7. MULTIPLY, RECORDING RESULTS, BY: successive whole numbers
   - a. Starting: with the lowest multiplier which yields results in a band of interest
   - b. Omitting: multipliers which yield results in a band not of interest
   - c. Ending: with the highest multiplier which yields results in a band of interest
8. TO EACH RESULT RECORDED IN STEP 7:
   - a. ADD: the IF frequency, and RECORD the potential spurious response.
   - b. AND, from this indicated response, SUBTRACT: two times the IF frequency, and RECORD this additional potential response.

EXAMPLE

Operating frequency: 155.13 MHz; IF frequency: 5.3 MHz (low-side);
Total multiplication: 9

Oper Freq	−	IF Freq	=	Inj Freq	÷	Mult	=	Osc Freq
155.13		5.3		149.83		9		16.6477...

16.6477..	X	n	=		+	5.3	=	SPUR	−	10.6	=	SPUR
		7		116.5344				121.8344				111.2344
		8		133.1822				138.4822				127.8822
		9		149.8300				oper freq				144.5300
		10		166.4777				171.7777				161.1777
		11		183.1255				188.4255				177.8255

Figure 8

CALCULATING POTENTIAL RECEIVER SPURIOUS RESPONSE FREQUENCIES
(with a pocket calculator)

B. RESPONSES ARISING FROM A MULTIPLE OF A SPURIOUS SIGNAL COMBINING WITH A MULTIPLE OF THE INJECTION

1.	ENTER: operating frequency	
2.	ADD or SUBTRACT: IF frequency (add, for high-side injection; subtract for low-side)	
3.	OBTAIN: injection frequency	
4.	MULTIPLY BY: Value chosen for M (multiple of injection)	
5.	OBTAIN: interim result	
6.	ADD: IF frequency	6a. SUBTRACT: IF frequency
7.	OBTAIN: interim result	7a. OBTAIN: interim result
8.	DIVIDE BY: lowest value chosen for N (multiple of spurious signal)	8a. DIVIDE BY: lowest value chosen for N (multiple of spurious signal)
9.	RECORD: spurious response	9a. RECORD: spurious response
10.	RE-ENTER: Step 7 result	10a. RE-ENTER: Step 7 result
11.	DIVIDE BY: next higher value of N	11a. DIVIDE BY: next higher value of N
12.	REPEAT: Steps 10 and 11 for successively higher values of N	12a. REPEAT: Steps 10a and 11a for successively higher values of N
13.	RE-ENTER: Step 3 result	13a. RE-ENTER: Step 3 result
14.	MULTIPLY BY: next higher value of M	14a. MULTIPLY BY: next higher value of M
15.	OBTAIN: interim value	15a. OBTAIN: interim value
16.	ADD: IF frequency	16a. SUBTRACT: IF frequency
17.	REPEAT: Steps 7-12	17a. REPEAT: Steps 7a-12a
18.	REPEAT: Steps 13-17 for successively higher values of M	

Figure 9

EXAMPLE CALCULATION

(procedure in Figure 9)

Operating frequency: 155.13; IF frequency: 5.3 (low-side)
Injection frequency (Step 3): 149.83

For injection multiplier (Step 4), M = 1:

5. Multiplied injection: 149.83

6. IF ADDED: 155.13

N Value	Spurious
4	38.7825
5	31.026
6	25.855

6a. IF SUBTRACTED: 144.53

N Value	Spurious
1	144.53
3	48.1767
5	28.906

For injection multiplier (Step 4), M = 2:

5. Multiplied injection: 299.66

6. IF ADDED: 304.96

N Value	Spurious
2	152.48
7	43.5657
8	38.12
9	33.8844
10	30.496

6a. IF SUBTRACTED: 294.36

N Value	Spurious
2	147.18
6	49.06
7	42.0514
8	36.795
9	32.7067
10	29.436

For injection multiplier (Step 4), M = 3:

5. Multiplied injection: 449.49

6. IF ADDED: 454.79

N Value	Spurious
1	454.79
2	151.5967
10	45.479

6a. IF SUBTRACTED: 444.19

N Value	Spurious
3	148.0633
10	44.419

Figure 10

BLOW YOUR MEMBERSHIP HORN

BY: ANDY MISSENDA

I realize that the intended message of this communication is being directed to an audience that has already "bought the product" so to speak. With your indulgence, let me press on in the hope that what I have to say will in some way better inform you about the Vehicular Technology Group and subsequently stimulate you to "blow the membership horn" on our behalf. Bear in mind that the analogy between statistics and bikini bathing suits - what they reveal are interesting but what they conceal are vital . This analogy does not apply to the following.

How many members are there in VTG? As you can see from the 5 year Membership Trend curve, the answer to that question depends upon what time of the year you ask it. Generally speaking our peak membership is in the 2500 - 2600 range and occurs during January. The valley that follows this peak is somewhat artificial as it represents the impact of headquarters purging the computer memory of all dues arrears members a around this time of the year. Whatever attrition occurs is made up by new applicants throughout the remainder of the year resulting in a rather quiescent trend.

What should the membership be? I suppose that depends upon which school you belong to, "the bigger the better" versus "quality rather than quantity". There is general agreement that the technologies addressed by our group are growing market wise. This is notably evident especially in the Mobile Communication, Automotive Electronics and Transportation disciplines. It would seem logical that our membership should be keeping pace with this growth. Our Advisory Committee (ADCOM) has adopted a 5 year goal plan which calls for a 10% membership increase per year during this period. This plan would give us over 4000 members by 1980.

What are the benefits of VTG membership? I'm sure that you've heard all the standard ones, i.e., quarterly publications (Transactions and Newsletter), National Conference, local chapter activities, etc. Let me expand a little on the chapters before I describe what, in my opinion, is the most significant attribute of VTG membership. As you can see from the table below, approximately 50% of the current members reside in areas which have active, local chapters.

	CHAPTER MEMBERS
Region 1:	
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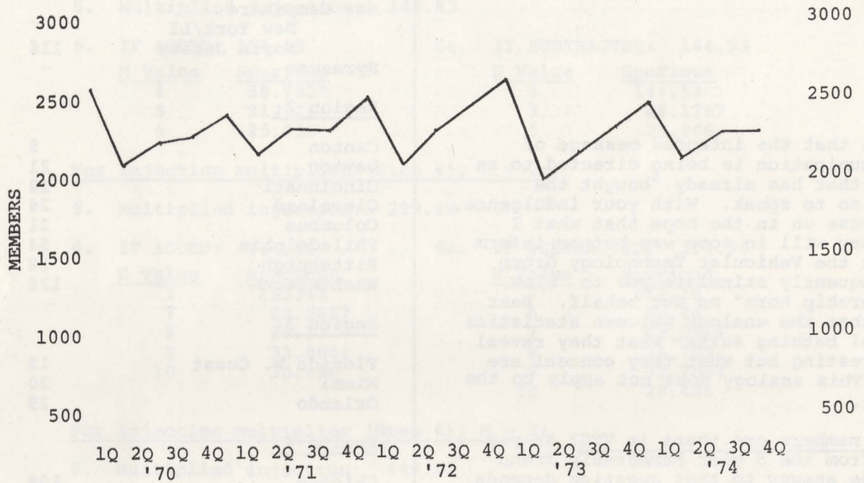
Cincinnati	12
Cleveland	26
Columbus	21
Philadelphia	54
Pittsburgh	18
Washington	126
Region 3:	
Florida W. Coast	15
Miami	20
Orlando	29
Region 4:	
Chicago	108
Nebraska	8
Southeastern Mich.	129
Region 5:	
Dallas	38
Region 6:	
Sacramento	25
San Francisco	123
L.A. Council	128
Region 7:	
Toronto	49
Montreal	31
Vancouver	9
TOTAL CHAPTER MEMBERS	1186

IEEE Headquarters requires a minimum of two general meetings per year for a chapter to remain on its active list. If you reside in one of these areas and have not been involved in its Chapter Activities, I suggest you contact one of the local officers and tell them why not.

I feel that the most positive aspect of VTG membership is the opportunity it provides to participate in the local and national activities of the group. This exposure guarantees contact with a large number of different individuals with a common technical interest and wide ranging experience and expertise in them. An unlimited technical growth opportunity is presented to the individual who takes advantage of this situation.

VEHICULAR TECHNOLOGY GROUP

5 YEAR MEMBERSHIP TREND



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S H SMITH

EASTERN N. CAROLINA
J W BAIRD
R M BURGER
JAMES P LEWIS
R C MORRIS
CHARLES S SAVIN
W B SLOOP
DAVID A STARK

WESTERN N. CAROLINA
DON E FREEMAN
J S HILL 2ND
I A SMITH JR

WINSTON-SALEM
RALPH W ROBERTS

Region Four

ARROWHEAD
W A STURBLEFIELD
JESSE D WHEATON

CALUMET
B ANDERHOUS
MYRON J BOYAJIAN
R D HANSEN
J HOLTON MINER
MICHAEL P STEUER
JAMES D STONE

CEDAR RAPIDS
MARGARET M ERNST
KAZUNARI HONJO
MILDRED A LAHR
F W PREZIOSI
A P SCHNEIDER

CENTRAL ILLINOIS
DAVID C AYERS
R W BURTNESS
F R GLOSSER
WAYNE L JOHNSON
W R MARGETTS
DON E PECK
LLOYD W RAVLIN
M A TALBOTT

CENTRAL INDIANA
THOMAS M ALLEBRANDI
STEPHEN P BIGGERSTAFF
D E NIEMOELLER
RONALD M POGUE
EVERETT R ROGGE
ALAN F SMITH
JAMES SUGIOKA
V C VANDERBILT JR
T F WOOD

CENTRAL IOWA
D L REIDT
B M MC CALL

CHICAGO
MOHAMED K ABDELAZEEZ
J S ADLER
L AMENEA
H A ARONSON
ROBERT J BAHR
Continued...

CHICAGO
JOSEPH BALSAMELLO
R L BORCHARDT
PATRICK J BOUTIER
A BRENNER
J R BROCKER
CARL N BROOKS
F BROUWER
E J BRUGLIERA
R T BRUMBAUGH
JAMES E BURNS
R W CARTER
J R CHERRY
J P COMBS
M COOPER
RICHARD D CORTRIGHT
MICHAEL C ANGELO JR
ALLEN L DAVIDSON
DOMINIC J DIGIANFILIPPO
A R DITTHARDT
R W DRONSUTH
JOHN M DUICH
ORVILLE M ENESS
MIKE J EIFE
NICHOLAS T FOTIADI
GENE R FRUEHLING
D W GALLAGHER
GLEN V GALLISON
JOSEPH R GANZEL
JACK GERMAIN
A M GOLDSTEIN
R GOLDSTEIN
MIKE A GORSKI
ROSS S GRAEBER JR
V GRAZIANO
R J HAJEK
CHARLES A HALL
GEORGE M HANUS
JAY D HAYNES
F H HILBERT
SAMIR HOODBHOY
H J HUMMEL
ANTHONY R JEDLINSKI
B KAHN
L M KAMINSKY
WALTER R KEEVIL
DENNIS T KELLY
GARTH R KENNEDY
IRA B KESSLER
J R KISSINGER
BRUCE C KLEIN
J H KOGEN
JOHN S KOLLER
G J KOWOLS
M S KPOOT
EUGENE J KRZYWICKI
K KULESHA
M A LACE
RICHARD I LITTLE
JOHN A LUTZOW
CHARLES N LYNK JR
ROGER D MADDEN
H MAGNUSKI
M MARKS
L J MARTINO
CHARLES J MATHEY
M A MICK
J J MIKULSKI
PAUL H MILENKOVIC
JOHN F MITCHELL
JOHN G NAUMAN
BRIAN C NELSEN
OLE K NILSSEN
ROBERT NUNAMAKER
JAMES C OBERG
R J ORWIN
L E PEPPERBERG
DAVID L POOLE
MYRON D PRESTON
WILLIAM A ROBINSON
P J ROHRET
T SALTZBERG
G D SCHLEICHER
H R SCHMITT
C J SCHULTZ
ROY A SENEFNER
F M SHAPIRA
THOMAS A SHARP
THOMAS R SIKORA
G B SMITH
S N STUDER JR
ARTHUR T SURGES
D G SWAN
DONALD L THOMANN
L R THOMAS
WILLIAM A THOMPSON
MICHAEL J TOIA
WILLIAM V TRANAVITCH JR
J T TUCKER
JOHN L VAHER
WILLIAM J WEISZ
RONALD G WESOLOSKI
C H WILLYARD
S A YEFSKY
FRANCIS R YESTER

FORT WAYNE
E D ALDRED
W H CONLEY
JON W FERRALL
JAMES E KEIM
A V KOROLENKO
PATRICK MILLER
D W SCOFIELD
ALAN B SHOWALTER
FRANK SPAYTH
A J WOZNIAK

ILLINOIS VALLEY
D BUERSCHINGER

IOWA-ILLINOIS
D H SYMONDS

MADISON
STANLEY F GUIF
ROBERT M TIMM

MILWAUKEE
B J CONNERTON
RICHARD DE VRIES
RONALD E FINET
ROBERT C GARNIER
ALBERT C HAJNY
F N KLEIN
FRANK H MARZ
M E MAZZONI
W S OSWALD
H W SCHUPPNER
B L SHRIVER
N F THOMAS
A C THOMPSON
RONALD WAGNER

NEBRASKA
R K CHERMLEY
R A HUNT
G H KUHN
RICHARD E LUTHER
C H OSTLER
L C PARK
CHRIS H RASMUSSEN JR
K H WYCOFF

NORTHEAST MICHIGAN
JOHN A CAROL JR
WILLIAM HOLL
WILLIAM P KEEL
DONALD C MC KINNON
J C MC LAUGHLIN
BRUCE H VAN VLACK

NORTHEASTERN WISCONSIN
ROBERT H BRYAN
A B BUCHANAN
RICHARD A DYKSTRA

ROCK RIVER VALLEY
DONALD P DE VALE
DAVID C NOEL

SIOUXLAND
GERALD E JENSEN

SOUTH BEND
DOUGLAS B LEATHEM
GILBERT E REDZINSKI
CHARLES J WALKER

SOUTHEASTERN MICHIGAN
NICHOLAS ALIMPICH
G B ANDREWS
JOSEPH R ASIK
E ATEMS
JAMES R ATKINSON
RAY AUGUSTINE
LEE W AUGUSTUS
JOHN E AUSEN
MORTON S BALBAN
PROVES R BANKS
WILLIAM F BANKS
F BAUER
JAMES W BENTLEY
SANDRA K BIDWELL
ALBERT C BLASCAK
ROBERT BOPCHERTS
MICHAEL L BORTA
CHARLES M BOYD
WESLEY D BOYER
ERWIN F BREDE
ROBERT BUCK
WESLEY W BUSHMAN
HENRY A CAMARGO
J N CASEY
JOHN F CASSIDY JR
RUSSELL A CHERRY
HENRY CHOW
WENDELL D CREPS
Q G CUNERALTO
W F DATWYLER
E C DENSTAEDT
C D DOMINGUEZ
RAYMOND DONOVAN
A C DOTY JR
R H DOUGHERTY
GLEN J DRELLISHAK
MICHEL L DUCHESNEAU
CLARENCE L EAGLE
G L ELLERY
R J EVANS
JAMES E FENTON
JOHN W FILSON
WILLIAM J FLEMING
DONALD FOURNIER JR
CHARLES T GAURONSKAS
ROMAN GAWLOWSKI
R J GENIK
K B GENTRY
G M GILKEY
RICHARD P GLASER
D M GRIMES
E A HANYSZ
SAMUEL B HOLCMAN
RICHARD A HOOVER
L R HOWARD
DAVID S HOWARTH
JACK E HUNSICKER
M JACOBS
TREVOR O JONES
F L KAHLE
WILLIAM E KETEL

JOHN R KILAR
J P KING
C A KOLENDA
ROGER G KOZLOWSKI
NEAL L LAURANCE
CLARK E LOWMAN
ALVIN E MARSHALL
W J MC ENROE
WALLACE W MC KIM
D A MILLER
JOSEPH L MONTGOMERY
GEORGE W MORRIS 3RD
W WALLACE MURRAY
R H MYERS
JAMES C NEISCH
HAROLD S NEWMAN
KENNETH A NIEMI
JEFF D OWENS
ROBERT H PARKER
STEVAN H PENNER
GEORGE E PLATZER JR
C R PLONSKY
WILLIAM G RACO
LAWRENCE F RAPP
NORMAN RAUTIOLA
JAMES H RILLINGS
DANIEL E ROBB
S RUDOFSKY
GARY J RUDOWSKI
T P RYKALA
ALLAN L SANDERSON
ORAN A SAUDER
A A SBAITI
T L SCHALLER
ROBERT J SCHAUL
GERALD C SCOTT
D L SHEPARD
DAVID C SMITH
ELMER W SOLDAN
ROBERT G STEFANEK
WILFRED J SWIECKI
E A TAURIAINEN
J TELMET
ROBERT W TERHUNE
C R TIEMAN
WILLIAM G TRABOLD
JOSEPH A TREMBA
M A TUKSAL
JOHN L TUNGL
H B TYSON
HERBERT J VAN HASSEL
J H VARTERASIAN
PAUL WAGNER
G E WANTTAJA
ROGER D WEBSTER
GREGORY C WHITE
RALPH V WILHELM
DENNIS F WILKIE
SCOTT A WILKINS
WALTER B WILLIAMS
FULTON K WOO
EDWARD YEE
JOHNSON S YUN
JOHN E ZAJAC
T W ZEIGLER JR
F L ZEISLER
J F ZIOMEK

SOUTHERN MINNESOTA
G W ABRAHAM
DAVID A ADAMS
E F JOHNSON
H D SCHMIDTKE

TWIN CITIES
V P BOLLESEN
R C CASE
KENNETH K DOLS
W L GARRARD JR
GARY GOLD
ROBERT A HIGGINS
A LIEPA
WILLIAM H LONG
P R MC CARTHY
JAMES C NELSON
J W NESTING
THOMAS J QUINN JR
R G RICHARDSON
H D SORUM
MARK C SPEAR
JEROME R STOCKTON
L E SWANSON
R D TOBIN JR

WEST MICHIGAN
R W CARTER
IVAN J DE WITT
J R HOOGESTEGER
G L LARSON
NEWELL D SAIGEON
RONALD E STRAIT
G WILCOX

Region Five

ARKANSAS
RICHARD C MIDDLETON
RICKEY H STACKS

BEAUMONT
H E RILEY

CENTRAL TEXAS
DALE L BUNDAY
LEWIS S FOUNTAIN
GEORGE L KING
J D MOORE
G F MUNSCH
L A PEASE
V D POOR
T M QUISENBERRY
ERNEST F WHITWORTH JR

CORPUS CHRISTI
CARLOS V LEAL

DALLAS
GEORGE R ALBIN
G C BERRY
LOUIS E BROWN
ALAN B CHAPMAN
F E CHEW
DAVID CLIFTON
W M CALLIN 2ND
DAVID G DEPPE
T M ELLIS
GENE H FORESTER
D W FRENCH
RAYMOND S HOUSTON
HOMER L HUDDLESTON
HAYDEN G JACKSON
DANIEL L KLESKEN
CHARLES L LEE
HORST LEUSCHNER
RICHARD L LUTHANS
J C LYNN
A J MARKWARDT
THOMAS J MC MULLIN
M E MEADOR
RICHARD C MORGAN 2ND
M B ONEAL
CONRAD L ROMBERG
T E SHAO
CHARLES SHOEMAKER
A C SIMMONS JR
R E SMITH
FRANK STEWART
J S STOVER
RAYMOND C TROTT
C W WEAVER
C A WHITE JR
IRA WIESENFELD
JULIAN WINSLOW
EUGENE WLODAREK

DENVER
ALBRECHT P BARSIS
R T EBERENDT
J L DEVITT
ROBERT W ELLISON
RICHARD K ETCHELLS
MYRON J HARVEY
JACK R JACKSON
WILBUR JEWELL
W G LEENERTS
ROBERT N LEHNERTZ
LOUIS E LIPP
JAMES R LOCKARD
NELSON E MC NULTY
J P MURRAY
H W NYLUND
BRUCE B REEDER
H A SCHNEIDER
J E SHAFER
TAYLOR S SHREVE
P R SIGNORELLI
JOHN J TARY
ROBERT C THURSTON
HERMAN E WELLS

EL PASO
ROBERT H CAMERON
ALFRED P STELL
W T THOMPSON

FORT WORTH
CHARLES H BEARD
R J BROWN JR
CHARLES C FREENY JR
ROBERT L FRENCH
CHARLES W GIBKE
D G KNIGHT
J T KOSKI
CHARLES E OTTINGER
GEORGE E WALTERS

HOUSTON
R H BUECHNER
R S CAPLAN
P E FRANKLIN
W T HUDGINS JR
CHARLES E HUGHES JR
W B JONES JR
ROY P MARSH JR
JOHN C MILLER JR
B J NANCE
GEORGE W PAYNE
JOHN R PURVIS
E L SCHAFER
F J SEMBERA
LOUIS L TAYLOR
C G TURNER
CHARLES M WHITE
CLEATES L WILFORD
J H WOFFORD

KANSAS CITY
THOMAS C BAKER JR
ANDREW T BEARD
DANIEL W BOSCH
C D CLARK
WILLIAM P CRAIG
KENNETH W FANN
KARL E GONSER
W R HATHORN
J B HEFFLEFINGER
MICHAEL S MCCALL
HAROLD A SMITH
ALEENS J TIBUS
W E VAN DYKE

OKLAHOMA CITY
SAMUEL K GEORGE
DONALD E GRAHAM
WILLIAM R REY

OZARK
MICHAEL P HARKEY

PANHANDLE
JOE A BETHANCOURT

PERMIAN BASIN
JOSEPH J PAPA
KENNETH H YATES

SAINT LOUIS
JOSEPH O ADEDUSAN
J C ANDREAS
F R ARNOLDY
CHARLES W BLOOD
JAMES O BONDI
KENNETH R DUNIPACE
R H FICKER
WALTER D HALFMAN
R G HOFT
OWEN C LICHTENWALNER
KEYHAN MOLAVI
JOHN S PAZDERA
DAVID R RASCH
THOMAS A ROTHERMICH
T J VAN IDERSTINE

SHREVEPORT
GERALD J ELSHOUT
L HURLEY
ROBERT M ROGERS

SOUTH PLAINS
MUHAMMAD LATIF

TULSA
J E HAWKINS
JOHN E JEDNACZ
BENJAMIN H KELLER
MICHAEL C SALEM

WEST CENTRAL TEXAS
A F RAMSEY
R G YOAS

WICHITA
DAVID H COWLING
E JAMES KOHMAN
ALAN B MEAD
VINCENT R SIPES
O O VRANA

Region Six

ALAMOGORDO-HOLLOMAN
NORMAN E ARNOLD 2ND

ALASKA
D A FULTON
ROBERT R HILL
ROBERT W RETHERFORD

ALBUQUERQUE
CHARLES M ANDERSON
HARLOW REENE
LORIN A BLACK JR
A L HUNTER
GARTH MAXAM
WILLIAM R REYNOLDS
RALPH E SCHAFFER
W M STRINGFELLOW

BOISE
L R LANGDON
H N LYNCH
KENT H MERIDETH

FORT HUACHUCA
C L GALLUP JR

HAWAII
P J BEHRENDS
HENRY E GAMACHE
STANLY E HARTER
ROBERT L HILLMAN
B K KINARIWALA

IDAHO
TIM L VOXTHEIMER

LAS VEGAS
J E LEWIS

MONTANA
JAMES W CORN
R E LEO
GARY L STIPE

PHOENIX
CHARLES BAUDO
ERNEST E CANNON
S M CHALMERS
RAE A ECHOLS
BERNARD H ELCOD
ADNA P JONES
S L KAGAN
ROBERT E KEMPER
R R LASH
WILLIAM F LIESKE
J F LOWENSTEIN
L D MARTIN
E D MENKES
HAROLD E NILES
DANIEL E NOBLE
JOHN K OLIVER JR
R E SAMUELSON
VINCENT J SCHIFANO
MAURICE D SHAPIRO
B E SIMMONS
J E SIMMONS
ALDEN STEVENSON
ROGER L WILLARD
JAMES A WILSON
GLENN W YOUNG JR

PORTLAND
RICHARD K BASS
CHARLES L BLIEGE
D L BROWN
GORDON R FREY
VAL S LAVA
KENNETH E MC FARLING
GLENN A MC LAUGHLIN
DUANE P MULLEN
R N PROVINCE
C K SHANKS
R E SHOW
ELMER L SURDAM

RICHLAND
WALTER V LOSCUTOFF
W G PARMELEE
GARY C THOMPSON

SACRAMENTO
PAUL E BOER
JAMES C BUDLER
WILLIAM L DOW
M S ELLIOTT
RONALD A GATTEN
MARION J HENSON
ALFRED E JACOBUS
WILLIAM M LEACHMAN
L E LUDEKENS
R E MAHAN
JOHN W MAIER JR
ROBERT A MASON
E STEWART NASCHKE
GLEN S NASH
G G NORTH
P K CNNIGIAN
PAUL E PULLIAM
JOSEPH READE
M B SAYRE
KARL E STOFFERS
ROLAND C VAN ESSEN
W L WADDELL
PETE H WANZENRIED
J G WEBB
JACK B WEST

SAN DIEGO
J L BECK
R R BIVELY
D E HOLCOMB JR
W J HOLT JR
A H KEITH
J M KENNEDY
M LE VON JR
WILLIAM C MARGIOTTA
FRANCIS N SALTUS
TERRY J SAMPITE
WILLIAM C SCHEMENSKY
EDDIE SIMON
ROGER L WEBB

SAN FRANCISCO
C A ANDREWS JR
MICHAEL P APCAR
GREGORY E AUSTIN
M H BAER
STANLEY W BALDWIN
R B BARNETT
JULES T BECKLEY
L M BELLEVILLE
L E BEST
J BRADLEY
J H BUFFUM
JOHN D BURKET
C C CALVERT
CARLTON A CARLSON
EDWARD D CARROLL
JOHN P COWARD
EDGAR S CRAVEN
DANIEL B DE BRA
R DE LIRAN
ROYCE D DETWILER
JOHN J DONEGAN
H DRAKE JR
R H DUHAMEL
MELVIN L ELLIOTT
STEVEN W ENGLAND
J D FAHEY
C G FERNALD
DANIEL M FILICE
R W GRIESE
ROBERT E GROSSENBACHER
DONALD L HAIR
J R HALL
JOHN F HAMILTON
DEXTER HARTKE
CARL L HARTSHORN 3RD
H J HATT
C D HEROLD JR
GWYNETH M HEYNES
ROBERT A HIRSCHFELD
D B HOISINGTON
R B HOOD
DOROTHY A HUTSON
A D HYNE
R A ISBERG
R ROGER JOHNSON
M H JONES
BRUCE C JORDAN
WALTER E KAELIN
PHILIP M KANE
JEFFREY N KATZ
K KAWAHATA
J A KIRTLAND
H M KOHLSTADT
JAMES A KRIEWALL
RONALD C KUNZELMAN
RICHARD N LANE
MARCUS C LEH
DAVID K LONG
ROBERT C MACATAGAN
A F MCCOLE
MARTIN MELNICK
IRA G MILLER
RICHARD H MOORE
R MORTON
THOMAS J MOYER
L O NELSON
CRAIG M NICHOLSON
E E NOLAN
B R NOVAK
W H NYE
WALLACE OLIVER
ALVER E OLSON
CARL B OLSON
TAD L OLSON
JAMES F PARKER
W R PATTON
D R PEARSON
P A PEARSON
JAIME E PERA
JOHN PESCHON
ROSS PETERSON
P PFENNCE JR
M H POSTMAN
DON ROWE
C A RYBINSKI JR
WILLIAM H SAYER JR
RAYMOND H SCHMIDT
JAMES C SCHMOCK
PERRY E SEAL
RICHARD J SEGERSTROM
H D SEIELSTAD
D P SHABATURA
R A SHEPERD
F R SHOEMAKER
HUGH SMITH
STEPHEN C SNELL
SALIM S SOLOMON
TADD E SPICER
BERTON H STEPHENS
EDWARD C STERLING 3RD
WALTER SUTTON
ROY J TOTH
GEORGE L TURIN
CHARLES A VAN LEEUWEN
V J VAN VELZER
V H WAIGHT
H M WATSON
MAX E WATSON
CARROLL WHITSON
IVAN WILENKEN
N A WILLIAMS
F E WILSON
THOMAS G WILSON JR
GENE V WINANS
A F WOLCOW
GUY W WOOD
B K WRIGHT
S YAKAHI
YASUO J YOSHINO
MARK E YOUNG
TERRENCE J YUNG
STEVEN S ZYSKI

SEATTLE
JOHN P AURELIUS
R O BARNES
ROBERT S BAX
J W BAZHAW
MAX F BICE
J C BLACK
JOHN E CRAMER
P A CURYEE
NEIL FAULKNER
ERIC FISHER
J A GOOSMAN
F H HALSTEAD JR
PAUL S HAUGE
ALAN D MOBERG
ROSCOE A MORRIS
F B MOSSMAN
WALTER T NIEMI
PAUL C PIGUET
CURTIS E PORTERFIELD
R G QUANTZ
LESTER W SCHEUNEMANN
J F TALBOT
KERMIT J THOMPSON
HAROLD C TODD
A C WHEELER

SPOKANE
LEO E BAKER
D P GORMAN
D A VERSTEEG

TUCSON
DAVID B CROZIER
E A HAYES
EARL A KIRCHNER
F R MICHALK
D W RICHARDS

UTAH
ALFRED G BULLETT
R M MCKEOWN
F S RUDD
B J SCHOCHET
DAVID A SOSS

LOS ANGELES COUNCIL

BUENAVENTURA
PERCY R CALKINS
E G DALGLEISH
JAMES A DELAMETER
GASTON G POULIN

CHINA LAKE
JULES J GHYSELINCK
W E WHITING

FOOTHILL
J N CONSTANT
J E GRAY
DONALD HENLEY JR
D L MACDONALD
DAVID R MC CROSKEY
J P NYHAN
M A ROBBINS
RONALD R ROSS
P J SAUTTER
J A SCHMITTENDORF
R D SMITH
WILLIAM J VANETTES

MET. LOS ANGELES
GLENN A BERRY
J T BLAKE
J R COIL
ROBERT C CRABB
C R CRAWFORD
ROBERT H FRASER
P O GOODER
FREDERIC J. HAMMOND
ERWIN HAUSMANN
JOHN G JUNG
YOUNG W LEE
E K MITCHELL
J P MUMAW
CHARLES E SEAL
W K SHAW
T H TAKEMOTO
JOHN A ZEMAN

ORANGE COUNTY
R W CARPENTER
JONATHAN M CHATTIN
MELVIN E CHESTER
JOHN E COOLIDGE
S T COSTANZA
STANLEY B DEMES
MIHAI C DEMETRESCU
D R DIVICK
DONALD L EWING
FRANK T FORNASON
LEE W FOSTER
ROY B GENGER
GARY DAVID GRAY
WILLIAM E HART
LARRY L HENDERSON
VINCENT R HOHMAN
S IWAKOSHI
J S JOHNSON
BRANCH P KERFOOT
D O MANN
DON F MATSUMIYA
JEAN P MILLER
GORDON E PERRY
SPENCER A PORTER
IAN G TERVET

SAN FERNANDO VALLEY
EMIL J BOZIGAR
W J CLING JR
F D COCHRAN
J J CUARRERA
KLAUS HAASE
ALBERT H HART
R B HARTLEY
J G HOFELD
RALPH J KOEPNER
TED H LEWIS
H M MARGOLSKY
D C MCCROSKEY
H D MCKAY
W C MC REA
DALE J MISCZYNSKI
WILLIAM B POHLMAN
STAN PRO
A J SCHNEIDER
S D SCHREYER
E H SCOTT
ARTHUR R TROUT
CARL H YACKEY JR
CHARLES H ZAUFT

SAN GABRIEL VALLEY
GERALD O BURNHAM
MAURICE E KENNEDY
CHARLES KIRSTEN
BART N LOCANTHI JR
P C NURCHES
A R PATTERSON
OTTO A REICHARDT
MICHAEL P TUROK

SANTA BARBARA
ARTHUR J BOSSE
DALE CLARK
PATRICK J DUNNE
JOHN T GAFFEY
THOMAS A KRIDESKY
S H LANE
ROBERT J MC MILLIN
B A NIKODEMSKI
MICHAEL C SUITS

SANTA MONICA BAY
JAMES O EASTON
G FISLER
L G FIELDS
K O FUGATE
C R LINDHELM
M H MIZELL
R M PETERSON
E C RAU
THOMAS N RUBINSTEIN
A J SAPPER
S SENSIPER
C A SORENSEN
D D STELLMACHER
E KENNETH TAYLOR
ROBERT L UNDERWOOD

SOUTH BAY HARBOR
ROBERT P CHEVRON
H G CORLETT
DAVID M CROCKETT
R R EDWARDS
ROBERT E HEIL
J A HUGHES
T J JORDAN
N R KRAMER
PAUL M MC CLUSKEY
R M MCKECHNIE
DALE W MILLIGAN
K A MOORE
GEORGE E RIGGINS JR
S SHOHARA
D W THOMAS
R THORENSEN
ROBERT D WANSELOW

VANDENBERG
CHARLES D BORDEN
JAY B MANAHAN

Region Seven

CENTRAL CANADA COUNCIL

BAY OF QUINTE
RICHARD C JOHNSTON

HAMILTON
C W ELLIOT
DONALD H KINGSWOOD

NIAGARA-INTERNATIONAL
JOSEPH J CHARO

TORONTO
G M BEDINGHAM
R G BENNETT
JERRY J BEZNER
C J BRIDGLAND
EDWARD R BRUNKS
J G BURLEY
B CASTERLINE
CHENG S CHIANG
RUDOLF G DE BUDA
S B DEWAN
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HIROTSUGU TAOKA
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T TSUMURA
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We invite your active participation and attendance at NTC '74 to be held in San Diego on December 2-4, 1974. Note the theme is "NEW TRENDS IN COMMUNICATIONS." This conference will provide a unique opportunity to stay abreast of this dynamic and increasingly important field!

Topics: Communication switching, space communications, wired cities technology, energy impact on communications, communication alternatives to transportation.

Sponsors: Communications Society, Aerospace and Electronic Systems Society, Geoscience Electronics Group, and the San Diego Section.

1974 IEEE INTERNATIONAL ELECTRON DEVICES MEETING

To be held December 9-11, 1974, Washington, D.C. The Annual Technical Meeting of the Electron Devices Group will be held at the Washington Hilton Hotel in Washington, D.C., December 9-11, 1974. This meeting will emphasize new and significant aspects of research, development, design, and manufacture of electron devices. Specific areas to be covered include:

Device Technology
Integrated Electronics
Solid-State Devices
Image Transducers & Optoelectronic Devices
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1974 VEHICULAR TECHNOLOGY GROUP CONFERENCE

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CANADIAN CONFERENCE ON COMMUNICATION AND POWER

Montreal, Canada, Nov. 7-8, 1974
Information: D. Mukhedkar, Ecole Polytechnique 2500 Ave. Marie-Guyard, Montreal, Canada H3T 1P8

FOURTH SEMICONDUCTOR LASER CONFERENCE

Atlanta, Ga., Nov. 18-20, 1974
Sponsor: IEEE Joint Council on Quantum Electronics.
Topics: Physical phenomena, material properties, device physics.
Information: A.R. Calawa, M.I.T. Lincoln Laboratory, P.O. Box 73, Lexington, Mass.02173.

THE IEEE INTERNATIONAL SOLID-STATE CIRCUITS CONFERENCE ...

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