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IEEE life members newsletter

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Keeping Abreast of New Technology

Charles W. Turner, Chair, IEEE Life Members Committee

The IEEE is, first and foremost, about electrotechnology and its increasingly wide range of applications, but not all members are aware of the sheer scale of the resources available. Membership in any of the IEEE's Organizational Units (OUs), such as Sections, Chapters, or Affinity Groups, offers a gateway to news of the latest advances in technology. Life Members (LMs) can continue to enjoy ready access to these resources by retaining, free of charge, their membership in these OUs.


IEEE Life Members Committee Chair Charles W. Turner

When I am asked how I manage to keep up to date on current news, I admit that I can only claim partial success, but that without the IEEE and its publications, like *IEEE Spectrum* and Society magazines, it would be much more difficult. I also point out that it helps that I belong to several IEEE Societies and keep in touch via the Internet through their webinars and the digital versions of their publications. "Staying connected" seems to be the best option for LMs to avoid losing touch.

If there is one common interest that LMs and other long-serving IEEE Members share, it is the incredible story of electronics. Some retired members, understandably, heave a sigh of relief when their workplace technical responsibilities have been discharged, but an enduring fascination with electronics keeps many others technically active as authors, reviewers, or consultants. LMs are also active in groups working on the history of technology, perhaps through IEEE Milestone projects.

Within the organizational structure of the IEEE, the Member and Geographic Activities Board is formally responsible for the administration of LM affairs, through the approximately 90 LM Affinity Groups (LMAGs). But it is the Technical Activities Board (TAB), managing more than 40 Societies and Councils, that is the natural home of most LMs. The hundreds of local Chapters of these Societies (distributed across all ten Regions) are, therefore, the logical contact point for members wishing to connect with the IEEE's technical activities. Any member of a Society is automatically a member of the Chapter in his or her Section. The Chapter provides opportunities for active participation, or for personal technical updating, through lectures and other meetings. There is also an ongoing need to recruit volunteers to serve on organizing committees at all levels: LMs have the depth of experience and the organizational skills that are often in short supply.

The IEEE Life Member Committee (LMC) welcomes initiatives by Societies to encourage retired and long-serving members to remain active. The IEEE Microwave Theory and Techniques Society recently formed an LM subcommittee (LMSC), the first Society to create a group to look after LM interests. Beginning with Region 10, it plans to start up nine other regional LMSC groups, with the goal of getting LMs involved with advances in microwave technology, such as the 5G revolution. The LMC hopes that more Societies will follow this example, recognizing that LMs have contributed so much to the advancement of their own special fields of interest over many years. A new Chapter can be formed by the submission of a petition from at least 12 members of the Society. Alternatively,

An Expensive Lesson

At IBM in Yorktown Heights in the 1960s, we were experimenting with read-only memory (ROM) for the System 360/40 that could be quickly changed with readily available equipment. Circuit boards were copper-plated, with the image of four 12 × 80 punched cards on each side, and covered with a thin insulating layer. A supply of punched cards was printed with conducting ink for the rectangular "holes" and for covering the verso. When one of these punched cards was pressed against the circuit board, the capacitance at the intact positions was interpreted as "1" and the lack of capacitive coupling at the punched-out positions as "0." Therefore, four two-sided boards with 32 cards could hold 30,720 b, enough for the 360/40's boot code. The ROM would not be affected by turning off the computer, and it could be quickly reset with cards prepared on the ubiquitous keypunch.

To ensure good capacitive coupling, the cards were pressed against the board by a custom-designed inflatable plastic bag sandwiched between the boards. The airflow would be controlled by a valve. I proposed a Teflon T-valve with copper fittings and a knob for turning a slotted cylinder that would connect either spur to the stem. The nipple on the stem would be connected by a tube to the airbag, one spur to a fish-tank air pump, and the other spur left open to allow deflating the bag to change cards.

Having worked summers in college as a draftsman, I prepared a drawing myself, with isometric, cross-section, and projection views and dimensions to three decimal places. I took my drawing to the Research Center's superb machine shop, where an old German machinist examined it carefully. He told me that it would take 9 h to machine it to the tolerances I had specified. The cost of the materials was negligible, so it would cost about US$540 dollars. My manager signed the authorization.

I tried it as soon as it was ready. It leaked, so I coated the cylinder with silicon grease. It still leaked. When I took it back to the machinist, he asked me what I was using it for, and then he showed me a US$1.75 glass air-valve that might serve. It did. I kept the Teflon valve on my desk for decades to remind me not to be shy about soliciting advice.

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The Mystery of the Missing P-Junction

In the early 1970s, Kearfott, a division of the Singer Corp., was working with the U.S. Air Force and NASA, defining a time-division multiplex command and response communication network. The network connected up to 32 avionic units via a single twisted pair of wires, operating at a frequency of 1 MHz. The multiplex system eventually became Mil-Std-1553.

While the standard was being developed, our team was charged, via an internal research and development (IR&D) program, to develop semiconductor(s) that would perform the encoding and decoding of the waveform that was to be used in the forthcoming Mil-Std-1553 specification.

Prior to taking on the task, our experience was in vacuum tubes, transistors, and small-scale semiconductors, such as Flip-Flops, And, Or, etc. We knew very little about large-scale integrated (LSI) circuits. Our research and design parameters, plus analysis and bread-boarding, led us to consider integrating all circuits onto one LSI semiconductor and to possibly use a new low-power semiconductor technology named *complimentary metal oxide on silicon* (*CMOS*). In addition, we were required to convert our transistor-level design to the P and N junction level of a semiconductor. During this period, minimal computer-aided-design was available for this level of LSI circuit design.

With further research, we located a start-up foundry in Valley Forge, Pennsylvania. It would work with us and manufacture the CMOS wafer/chips. To manufacture the wafers, we were required to supply the masks necessary for the multiple layers of the semiconductor (the P-layer, the N-layer, the conductor-layer, etc). Utilizing an X-Y plotting and cutting table, the initial mask-making process required plotting and cutting the physical shape of each circuit layer out of a plastic material called *Ruby-Lit*. A parallel IR&D effort developed a software program for the X-Y plotting and cutting table. The result generated a Ruby-Lit sheet for each layer. After photographing each Ruby-Lit layer and reducing it down to the wafer/chip size, a mask for each layer was manufactured. The Ruby-Lit sheets were then rolled up and stored for possible future use. The masks were sent the Pennsylvania wafer/chip foundry, and the first wafers were produced and delivered.

We received our first wafers and, with an unsophisticated straight pin probing tool, tested the functioning of the first encoder/decoder chip. Every output, except one, was functioning as designed. Further test and analysis determined that one of the output circuits had a faulty or missing P-junction. Our investigation led us to the Ruby-Lit layers, and following some razzing from fellow engineers, we found a piece of tape covering that particular P-junction. The tape had gotten photographed into the mask. With a new mask and new wafer, the problem was solved. Other design changes followed, but the laughing and ribbing continued.

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