

Men and Women Together Make RF/Microwaves Better

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The Women in Microwaves (WIM) reception at IMS 2022 is an excuse to meet colleagues of all genders and have a productive and fun time, with good food (if Ron gives us enough funds) at the end of a long conference day. As the authors believe and many of our male colleagues think, gender should not need to be a discussion topic among microwave engineers. We have more relevant topics to discuss—high power, high efficiency, low loss, calibration, wideband signals, and so on. All of us love our work and want to achieve technical excellence (Figure 1). We hope you will join us in person at the 2022 IEEE Microwave Theory and Techniques Society (MTT-S) International



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Microwave Symposium (IMS2022) in Denver to mingle, win some prizes [e.g., earrings and tie pins made of monolithic microwave integrated circuits (MMICs)], discuss interesting topics, and contribute to an IMS2022 Smith chart poster.

Why is there a WIM event at all? Why is there not a Men in Microwaves (MIM) event? In some sense, the IMS has been an entirely MIM

event for decades. The senior author remembers the first 10–15 years of her career when the speaker gift at the conference was a tie. It was appreciated and passed on to her husband, who, to this, date owns many MTT-S ties. It made little financial sense, of course, to make a handful of scarves and thousands of ties. There is clearly an imbalance in our field, considering that a bit more than 50% of the world

population is born female. We point out that the Smith chart enables people of all genders and creeds to speak the same language. So why is there an imbalance in gender representation [2]–[4]?

A glimpse from a historical perspective is interesting. In 1952, the Research Institute of America published a “manual,” which was distributed

by the Industrial Relations Division of the Hughes Aircraft Company [5]. It is a detailed set of instructions and suggestions on how to manage women workers. We believe that the title of the document, *How to Handle Women*, refers to the workplace, but the document itself certainly addresses personal life outside of the workplace as

well. Although we are sure that this was a well-intended article at the time, today, we find that some of the quotes might entertain readers, and they are summarized in Table 1.

The document also points out that women have better manual manipulation and color sense as well as more patience, and “That’s why women do consistently better at repetitive work . . . and such an efficient job in clerical occupations.” Linear and nonlinear regions of operation of female RF engineers, with the authors’ interpretation shown in Figure 2, are alluded to in the conclusion in [5]: “No doubt about it, sometimes they move in mysterious ways.”

Nevertheless, the conclusion is a positive one:

But the average woman is predictable to this extent: if she feels that she is treated fairly and that you recognize and like her as an individual in her own right, her gratitude will show up in her cooperation and real application to the job at hand. Can you ask for anything more?

Apparently, women were difficult to work with in 1952, so we decided to ask a few of our male colleagues how they feel in 2022. These anonymous quotes come with permission from both new and well-established colleagues in the microwave field, and are listed here:

- *Male Engineer (ME)1*: “RF products are prevalent in all areas of everyday life. End users are men, women, and children across the globe. Any successful engineering work needs to draw from the same diverse population its products serve. Thus, including women and other underrepresented groups in RF and microwave R&D is not only the right thing to do but the only way to maximize the quality of work and contribution to society.”
- *ME2*: “My wife engineer did not force me to chose two female coadvisors for my Ph.D. degree; I simply thought they were the best advisors. (I am saying this of my own free will.)”

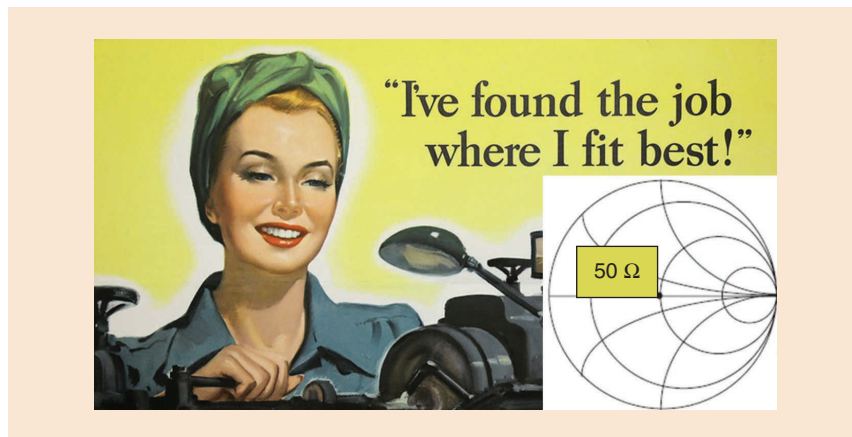


Figure 1. Rosy found a good impedance match by calibrating a network analyzer and connecting her well-designed circuit. (Adapted from [1].)

TABLE 1. Then and now.		
Topic [1]	Quote From [1], 1952	Comment, 70 Years Later
Physical differences between men and women	“. . . they [women] go through the physical and emotional cycles designed for them.”	No correlation of this nonlinearity has been observed in measured power amplifier intermodulation products.
	“Her muscles are long and slim, while a man’s muscles are made for heavier work.”	Long and slim fingers help with waveguide component assembly.
	“She can’t take extended pressure or long, unbroken periods of constant activity.”	. . . such as, for example, childbirth.
Logic and intuition	“Women’s logic is one of the deeper mysteries of life to the average male. It’s a waste of time to tell a woman she’s illogical.”	There is no reported female RF engineer who tried to match to a short circuit.
	“The simple truth is that women are more interested in people than in things.”	Finally, we are not told that we care more about money, jewelry, and clothing!
Female types	“Career woman: Marriage doesn’t interest her too much.”	Hmmm . . . (Why do you care?)
	“Married woman: This type of woman is usually a mature person with a deep sense of responsibility. And she does a steady, efficient job.”	Those of us who are married to men feel that we were more responsible before we had to take care of a husband and children.

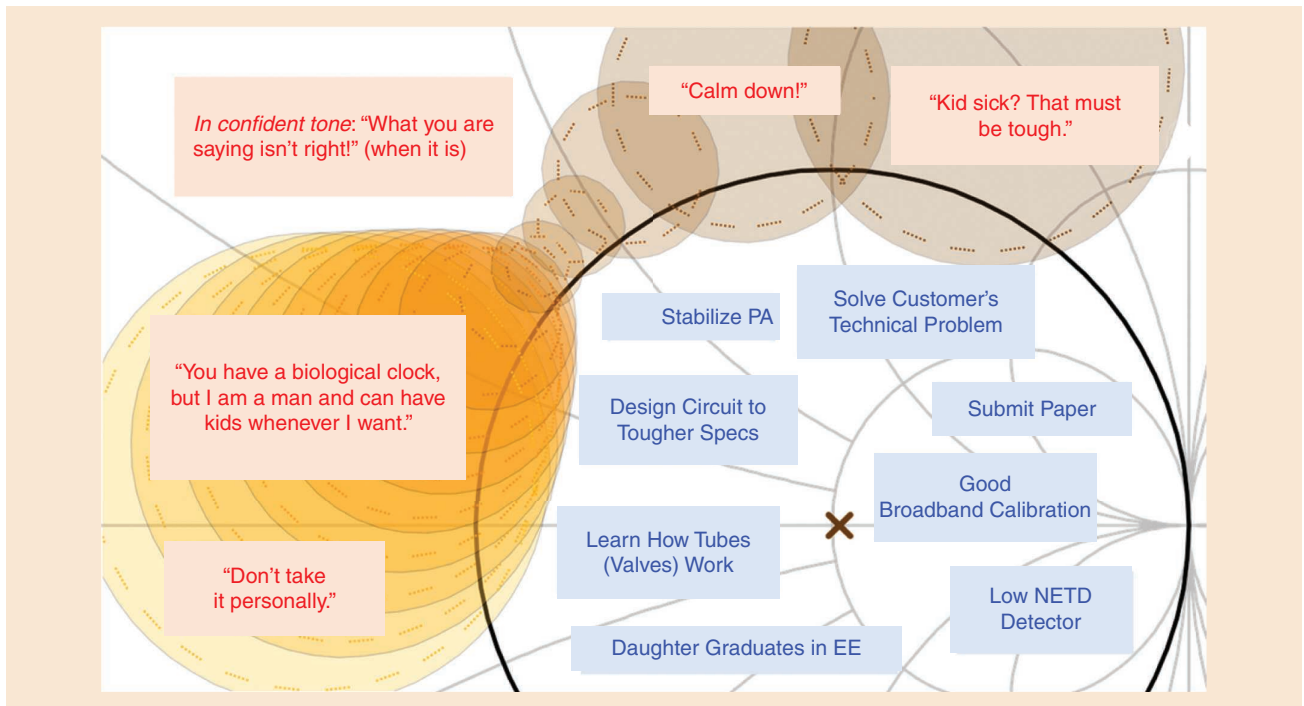


Figure 2. An example of stable and unstable regions of women in RF engineering. Quotes in the unstable region are not made up, and they result in a reflection coefficient $|\Gamma|$ of >1 and substantial gain at the expense of potentially useful supply power. EE: electrical engineering; PA: power amplifier; NETD: noise equivalent temperature difference.

- ME3: “Monoculture in agriculture upsets critical natural balances that take years to fix. Monoculture in engineering work is no different.”
- ME4: “The Hughes manual [5] points out that ‘During WW2, when

many women went to work for the first time, a group of learned analysts put out a pamphlet on the female employee: *Women*, they said, *are simply little men.*’ I am personally not interested in dating a ‘little man.’ And I love working

with Megan, Paige, Laila, Joeun, Amy, Sofia, and Kaitlin. It is great having a female advisor, who is there not just to train us to become technical experts but is also an academic ‘mom’ if we need her (and sometimes cooks for us).”

- ME5: “At Lockheed, there are a few women engineers, and they are great to work with. That is part of the reason I chose a female Ph.D. advisor and one that is a Lockheed Martin chair.”
- ME6: “It’s a rather sensitive subject, and I have a feeling that almost anything any man says will find some fraction of disapproval. If I am viewed as one who displays an ‘unbiased’ manner in ‘talking shop,’ whether it be with a male or female person, maybe this is simply due to my own rather limited dealings with women, having attended all-male schools; then a university that, at the time, had a 10:1 adverse ratio; and then going into an industry that was more

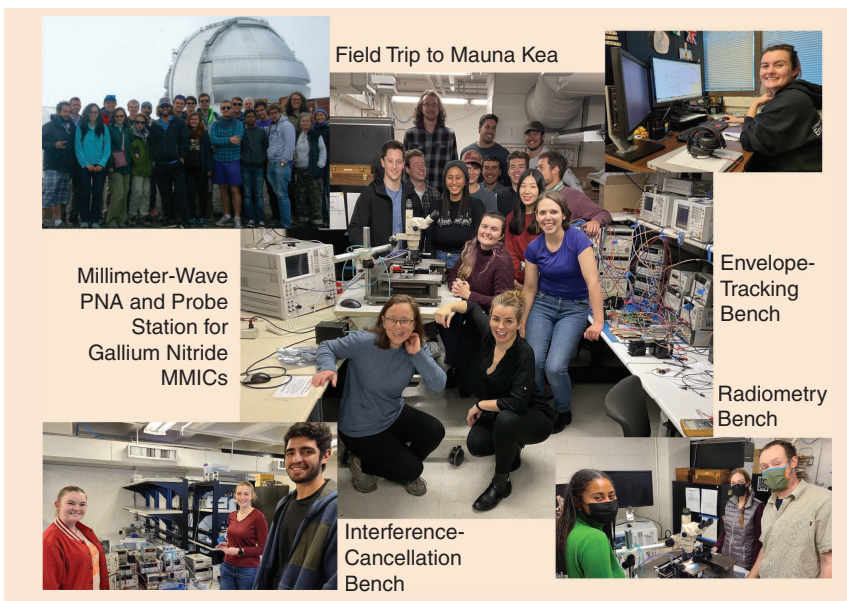


Figure 3. Microwaves at the University of Colorado, Boulder—please visit us if you are staying in the area after IMS2022. Contact zoja@colorado.edu.

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These included a group for Jewish Studies at Christopher Newport University. In addition, he was very supportive of the local performing arts and instrumental in maintaining the Greater Williamsburg Virginia Symphony when it was on the verge of closing.

Bertram traveled extensively. He and his family visited every continent

except Antarctica. He was a member of Rodef Sholem Congregation in Newport News and Temple Beth-El of Williamsburg. He is survived by his loving wife, Gladys Aaron; daughters Dr. Cynthia Aaron and Jill Aaron MacPherson (Donald); son Dr. Harry Aaron (Joan); and grandchildren Caileigh, Sarah, and David. He is also survived by a cherished extended family,

including brother Cyril Aaron (Patti); nieces and nephews Hugh Aaron (Laura), Debra Aaron (Bonnie), Rabbi Scott Aaron (Donni), and Jennifer Katz (Larry); and stepchildren Jeffrey Heilbraun, Harris Cohen (Karen), Brad Cohen, and Stuart Cohen (Lisa) as well as their children.



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like 1,000:1 against. But here we go—this is already looking like a hazardous line to proceed down! Like it or not, the microwave community is still very male dominated, and I am very sympathetic to women who are able to ride above the ‘boys-will-be-boys’ stuff and do good work. But here, again, tricky territory. What I have found myself concerned about is when women adopt an ‘OK, I will behave like one of the boys attitude, which I think should not be necessary; I’m fundamentally a ‘vive la difference’ male at heart!”

Even if our colleagues had not shared our views, women RF engineers believe that engineering is better with balance. We know we cannot improve the balance with a single event or effort, but, with WIM events, we can help create a welcoming environment for both new and well-established women professionals and a more fun and balanced environment for all of our colleagues.

We can encourage young women—and everyone else—to pursue the study of RF engineering if they find it interesting and useful. We authors realize that this is not a good match (50 Ω) for everyone, let alone every female. Laila’s father gave her and her sister connectors, screwdrivers, and an

oscilloscope and asked them to play with them and tell him if they liked them. Laila loved it; Luciana did not and became a businesswoman. Zoya taught all three daughters how to solder and calculate reflection coefficients. Nina is now an RF engineer (and the first author), Lena is cutting up mice and analyzing their cells, and Fiona is producing music and a certified welder.

We find this diversity of interests inspiring. Not only can we talk about jewelry and dresses but also what a microwave engineer can do to help improve a biology diagnostic or imaging instrument, help a lawyer prepare a patent, or digitally process music recordings, while biologists and musicians can learn how the front ends in their cell phones work.

Unsurprisingly, loving microwave engineering is not limited to gender, age, language, or beliefs—we are unified in our mastery of Maxwell’s equations and their approximations in circuit theory. Bringing up gender disparity in this context makes us all understandably uncomfortable. It is uncomfortable that we still have to talk about it in 2022, and it is uncomfortable that we are potentially missing exciting and important discoveries because of it!

Most of the organizers of the WIM IMS2022 event are a group of micro-

wave engineers from the University of Colorado, Boulder, shown in the lab in Figure 3. The authors of this article are very much looking forward to seeing you in person at the WIM event in Denver at IMS2022.

Acknowledgments

We thank all our male colleagues who show respect and have high expectations. Special thanks to those who provided quotes for this article; you know who you are.

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