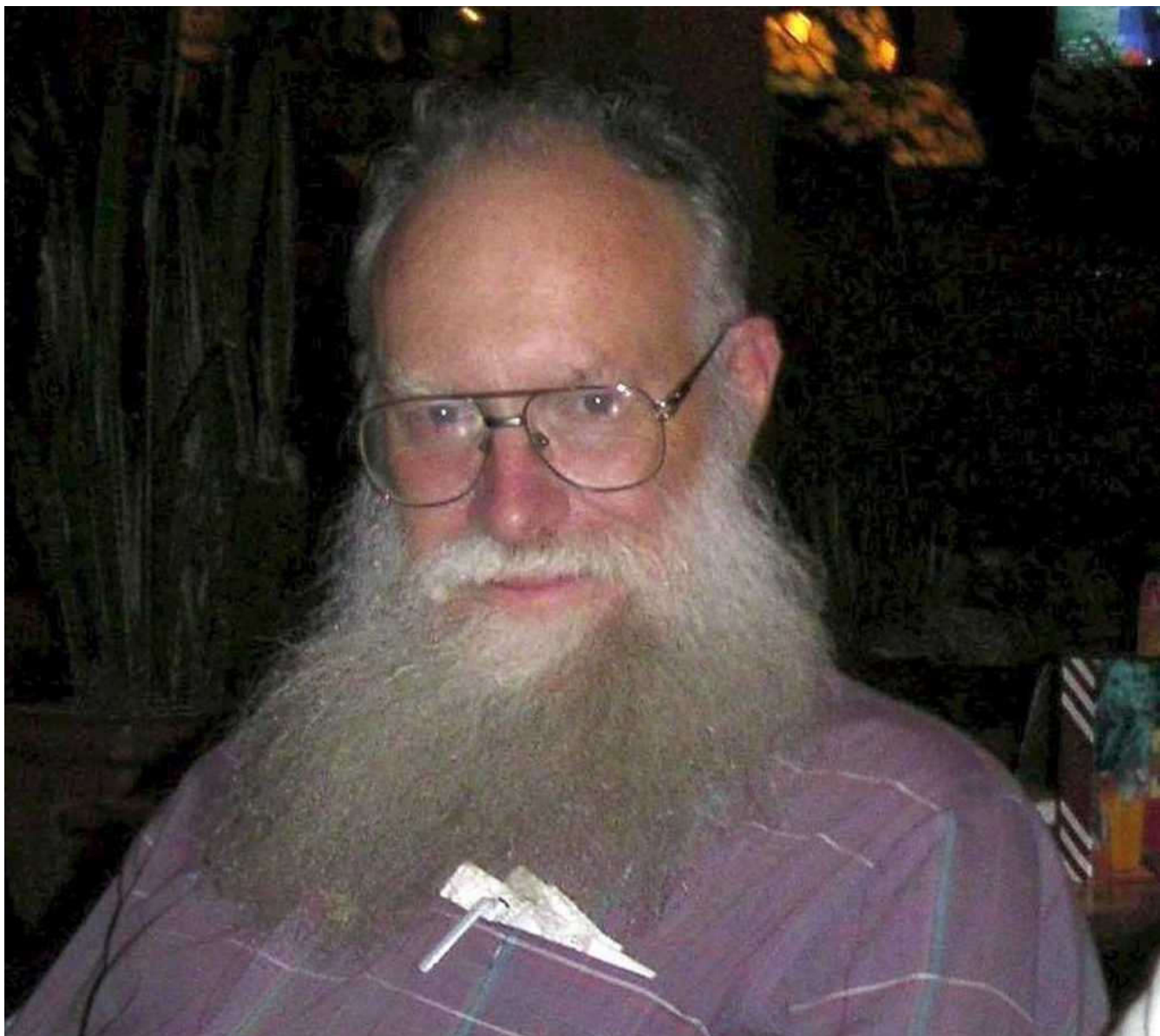




Rako Studios » Media » Tech » Electronics » Bob Pease, analog guru, died 5 years ago

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Bob Pease was a true standout, the gentleman genius.



Notorious analog engineer Bob Pease died five years ago, on June 18, 2011. His passing was all the more tragic since he died driving home from a remembrance for fellow analog great Jim Williams. Although it was a

Saturday, Bob had come to the service from his office at National Semiconductor, now Texas Instruments. My buddy has a saying, "Everyone wants to **be** somebody, no one wants to **become** somebody."

Bob's being the most famous analog designer was the result of his hard work becoming a brilliant engineer, with a passion for helping others. Fran Hoffart, retired Linear Tech apps engineer and former colleague recalls, "Citing a need for educating fellow engineers in the design of bandgap references, Bob anointed himself 'The Czar of Bandgaps,' complete with a quasi-military suit with a sword and a necklace made from metal TO-3 packages." He would help any engineer with a problem, even if it did not sell chips for National Semi. He would help those who joined him on his Himalayan treks. He would help his sons reach their dreams and help his wife Nancy in all her endeavors. He was both extremely intelligent and extremely kind, a very rare combination in Silicon Valley. Dennis Monticelli, retired fellow emeritus at Texas Instruments recollects, "I was a fresh college grad when Bob helped me by thoroughly editing my first application note. He also facilitated a connection with Bob Widlar."

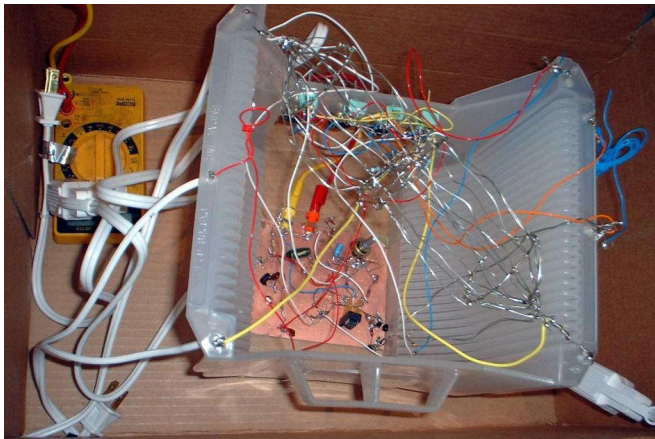
Beside smarts, Bob had wisdom. As staff scientist at National Semiconductor, it was natural that he knew analog chips and semiconductor technology. But Bob was first and foremost a system engineer. He was not at all a chip salesman. I credit this to his starting work at Philbrick Researches, where he designed tube op-amps. He knew what it was like to design and manufacture working hardware assembled from dozens of discrete components, including vacuum tubes. Silicon came later. TI fellow Monticelli notes, "Bob would often say that the actual active device did not matter. If you were a good analog engineer it didn't matter whether it was a vacuum tube, a germanium transistor, or a bipolar or MOSFET transistor. He felt he could design with anything, and he probably could."

After coming to National Semi, Bob learned analog IC design, back in the days of hand-cut Rubylith masks. There was no Spice simulator back then, and Pease had deep ridicule for engineers that relied on computer simulations, instead of thinking through the problem and making some quick back-of-envelope calculations. He accepted that Spice was useful especially for inexperienced engineers, but was concerned that engineers were substituting computer smarts for real smarts. Joe Sousa, curator of the Philbrick Archive comments, "Regarding Spice, he tended towards hyperbole. He certainly had no patience for the over-use of Spice. At one point I asked what he thought about analog simulation at Philbrick, but he did not answer. When he started at Philbrick in 1961, it was morphing from an analog simulation company to the first op-amp supplier for end-user applications."



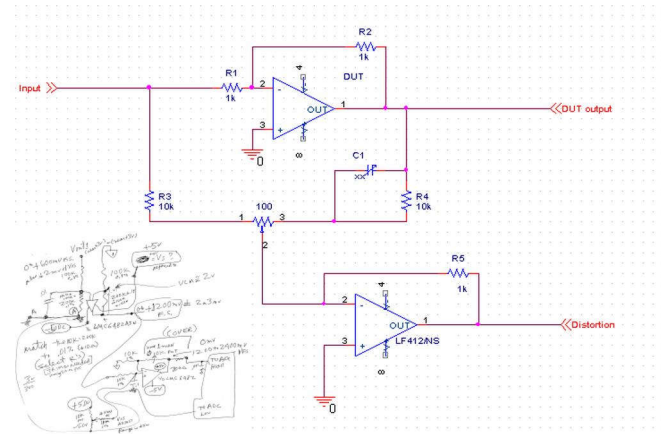
National Semi would have demo days to showcase new products and designs.

Pease would show up in his hiking jacket festooned with Nepal patches. His prototype techniques were famous. He would string together circuits by air-wiring components to the chips, as well as dead-bugging the chips to a board, and incorporating evaluation boards sold by National. Paul Grohe, Pease's protege, now precision signal path application engineer at Texas Instruments points out, "The air-ball on the front of his troubleshooting book is the LM131 V-F (voltage to frequency) breadboard. He always used low-ohm resistors instead of wire to model trace resistance, and megohm resistors and reversed diodes as 'supports' to model the substrate effects." Pease also loved to use plastic wafer carrier buckets, in this case inverted to give him a place to mount some banana jacks.



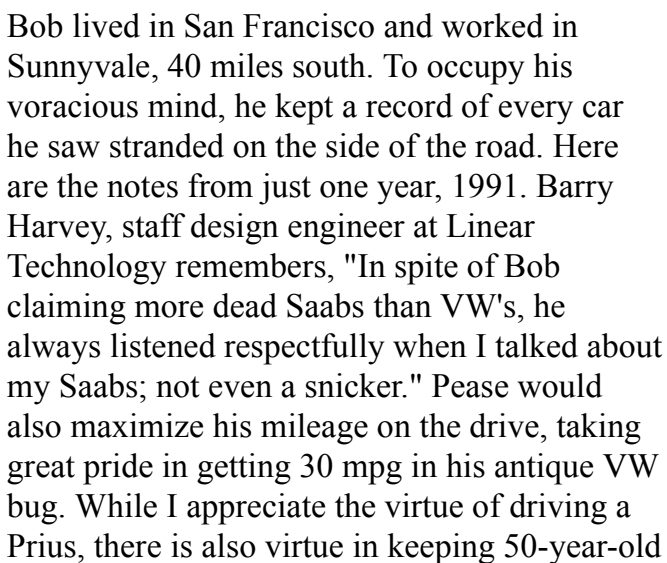
Here we see another wafer carrier, with the circuits suspended in mid-air. This circuit is a current measurement circuit for 60Hz ac wall voltage, you can see the cord on the left. In this case Pease used the wafer carrier for safety as well. With a clear plastic cover, people could check out the circuit without getting electrocuted. These air-wired circuits had some advantages, due to the low capacitance of the air-wiring, and some drawbacks, because of the greater inductance of the long leads. At low frequencies, neither of these mattered too much.

Monticelli notes, "Bob did stay away from high-speed circuitry. His bread-boarding technique could only go so far and he mistrusted the simulator."



Pease's circuits could be simple or complex. The hand-drawn schematic of the current sensor (inset) was complicated. His method to evaluate the distortion of an amplifier, which I re-drew in OrCAD, was a picture of simplicity. Although National's parts had poorer dc offset voltage than some at the time, Pease was an expert in using ac circuits to great advantage. While Pease's complex circuit above is a bit moot, since mixed-signal chips can better measure ac currents, the simple circuit is still a great way to evaluate distortion, and it is a method that is very low in cost. Hoffart notes, "Bob designed some of the first 3-terminal negative voltage regulators and enjoyed designing V to F [voltage-to-frequency] converter circuits." Paul Grohe recalls two specific Pease parts, the LM337 regulator and the LM331 V-F converter.

Pease was always known as a wacky character, starting with the days when he used to sprint up the steps in lederhosen at MIT. I asked him about it, and he responded "That is how I got my exercise in between all the studying. Since it made me sweat, I wore shorts."



Semiconductor engineering pays very well, so I asked Bob why he didn't move closer to his job, to save himself the grueling commute. He responded that both his sons were in a church choir that they really liked, and he could not take them away from something they so enjoyed. Nancy Pease recalls, "Both Ben and Jon were boy sopranos, first at St. Paul Cathedral in Boston then at Grace Cathedral in San Francisco where they attended Cathedral School for Boys. We were both active members both while they were there and after they went on to high school and college. Bob was usually working the sound booth recording organ or choir concerts, or ushering." This was typical for Bob, willing to suffer a bit for the benefit of others. When flying around the world on the analog seminar, Bob would fly coach even though we had authorization for business class.

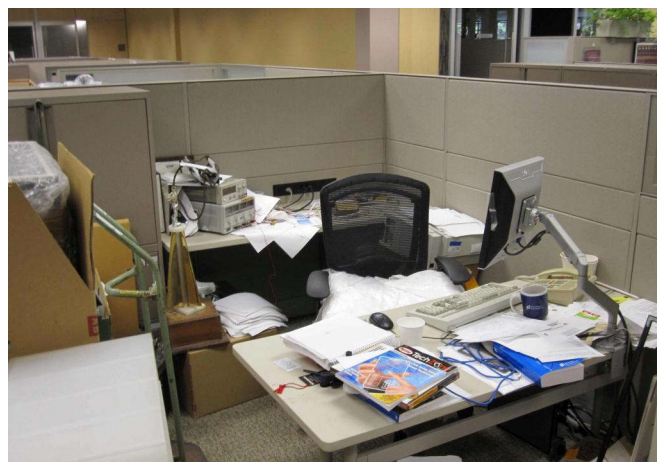
I told him that was foolish, he was only saving the CEO's money. Pease rebuked me, "Its **our** money I am saving."



Bob was notorious for his design chops, but also for his messy office. Here is one of his early offices at National, where he won a contest from a newspaper for messiest desk. Nancy recollects, "It was a San Jose Mercury News messiest desk contest. Someone entered a picture of his office in his behalf, and asked him if he won a big prize would he share it. Bob didn't know what the prize was at the time. The competition was in no way up to his entry, so they gave him 1st, 2nd, and 3rd prizes. The prize was for office furniture. Bob sold it to National and threw a pizza party with the money." I took a video of Bob's office when I worked at National Semi.

The Sunnyvale Fire Marshal said he would cite National for the office. Fran Hoffart remembers, "After being told that his desk presented a fire hazard, Pease hung a smoke detector from the ceiling."

Monticelli recalls, "I had the privilege of *managing Bob*, an oxymoron if there ever was one, back in the late 1980's. It was only a matter of time before Bob's legendary messy office got me into trouble with the Fire Marshal. Not wanting to reign Bob in excessively, I decided to take advantage of the fact that the Fire Marshal did his rounds on Saturday. I told Bob I would look the other way during the week, but end-of-day Friday I reserved the right to drag a 2"x4" lumber stud over the top of his cubicle. Whatever it caught was gone. You can imagine Bob's creative response. Monday morning the office began to disgorge papers through every pore. That grew linearly until late Friday, when there was an abrupt reset as all papers were suddenly sucked back in. I think it represented the most impressive sawtooth waveform Pease ever built."



Engineer extraordinaire Alan Martin, applications manager at Texas Instruments and member of group technical staff, was thoughtful enough to snap pictures of Bob's office soon after he died. Bob cleaned up his act after he

moved into Building C. Alan is tasked with organizing all of Pease's papers at Texas Instruments. He helped supervise getting Bob's papers removed from his home in San Francisco. Bob's widow Nancy remembers, "At that time they took a couple hundred xerox boxes out of the house and two years ago five pallets of stuff. Joe Sousa came and got a lot of Philbrick stuff. I had to go through it all looking for any personal stuff, but never did find where he stashed that. They also culled the MANY, many duplicate copies." Alan thought he was getting ahead of things until Nancy said, "Do you know about the two storage units in San Mateo?" Alan observes, "This is one of those situations where you volunteer to do something noble, not realizing what you are getting into. I get regular inquiries from the campus facilities manager about progress; to the point I now dodge him in the lunchroom." Joe Sousa recalls, "My interaction with Bob was because of the Philbrick Archive. He contributed many emails, many of which I found relevant to Philbrick history and posted in the Archive. He also willed to me his Philbrick papers, which I collected from Nancy shortly after his death."

Nancy Pease was Bob's rock and ideal companion. Together for 49 years, it was no surprise that Bob stuck by his college sweetheart. How she put up with his messiness or hoarding or compulsions was something we all wondered about, however. Much to Bob's benefit, Nancy stood by him all those years and would enjoy treks in Nepal as well as summer vacations in their house on Cape Cod.

Nancy remarks, "Bob and I were married 49 years, 10 months and 23 days. I loved him dearly but didn't always quite like him, especially for his hoarding tendencies. But I accepted him for who he was. We weren't college sweethearts, but I was dating a friend of his who hung out at the MIT outing club.



I think the friend got Bob a job at Philbrick after his junior year. When we were married he was still 20 and I was an old woman of 23. He was 21 a few weeks later and graduated from MIT the next month. I had gone on a winter mountaineering trip in the White Mountains in New Hampshire with Bob and three guys in a 1959 Beetle. I think he figured if I could survive that, I was the one for him. It took me a few months to make up my mind, but he was brilliant, sweet, and I made the right decision."

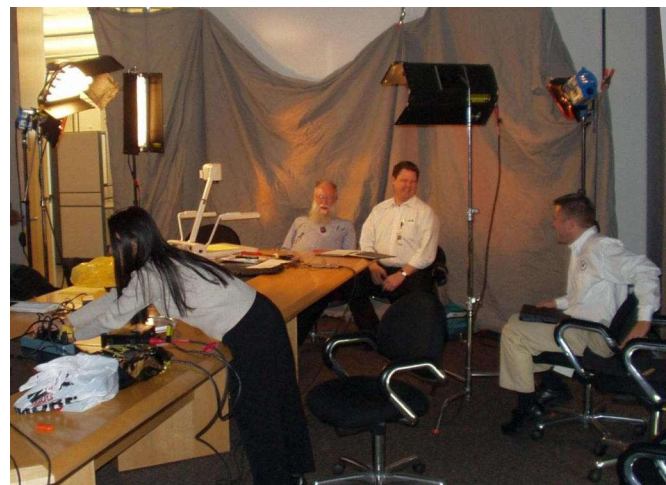
Another thing Nancy had to put up with was Bob's extended training tours all over the world. Here is Bob in 2000, with his ever-present video camera. Marcello Salvatierra, Bob's close friend and retired Texas Instruments amplifier application engineer recalls, "During the Analog Seminar he would record every meal on video. I asked why and he responded, 'So I can enjoy it again later'". Indeed, the first time I met Pease was shortly after I moved to Silicon Valley. He was in the Fry's Electronics store and filming a short clip



of the long lines at the registers. I went up to him, awestruck, and like with everyone, he was cordial and friendly. I met him again at an EETimes analog conference and he remembered the first meeting, almost 10 years earlier. When I got tired of start-up companies, Bob was instrumental in getting me a job at National Semiconductor, although he never told me at the time. He was such a modest gentleman, one of the things that made him great.

National Semi did not charge engineers to attend the annual design seminar series. Indeed, they got a free lunch. I doubt attendees realized how much it cost. Bob and six other high-dollar engineers would fly to their location, stay at hotels, rent a conference room, and eat at the hotel restaurant. Bob had convinced National Semi that if they could get 30 engineers to sign up, we should go to their city. Gayle Bullock, media relations manager at Texas Instruments observes, "We didn't have the ability to connect electronically with folks as well as we do today, and Bob felt that person-to-person learning was vital. Few companies supported this model as well as National Semiconductor, but Bob and his team made the investment worth it. He was the analog rock star of the day."

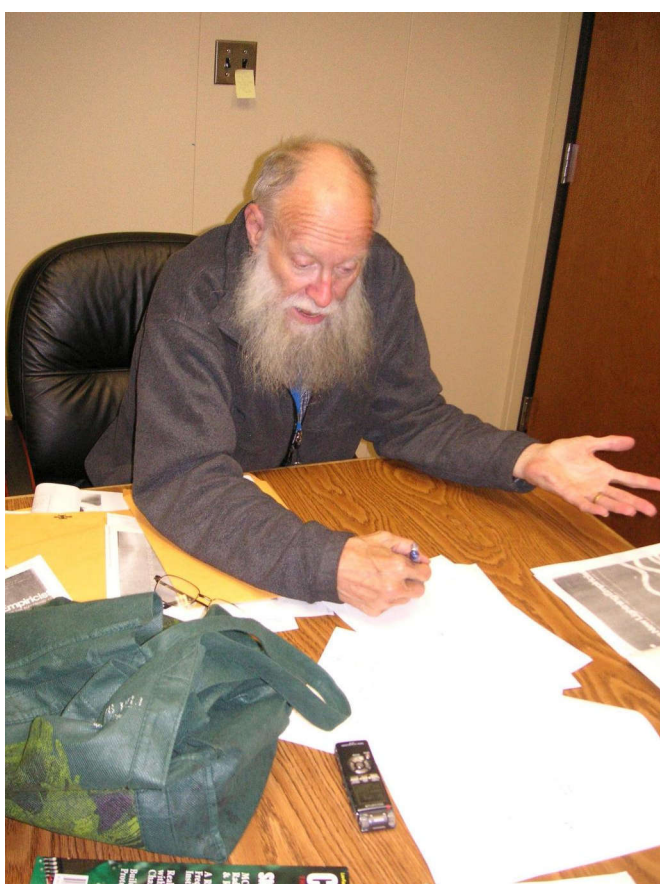
Such small audiences were not the norm. At one point Bob felt National Semi was underserving foreign engineers struggling with analog design. So after one seminar series, he decided to fly, coach of course, to India and China to give the entire seminar by himself. After all, he had just heard it presented 30 or 40 times by the team. Bob defended his decision but there was a great deal of drama around this independent endeavor. The seminar he did in India had 600 people before the fire marshals had to stop new arrivals. The China seminar Bob did was equally popular. Bob was instrumental in bringing the wonder of analog to regions outside of the U.S., at a time when the cost and effort was largely prohibitive.



Bob also used his influence to get me on the Bob Pease show, later called the Analog by Design show. Here you see web production manager Tanya Quach getting the plug strip straight, while Bob slouches in his chair, next to me talking with Paul Grohe, Bob's protege, who he hired right out of college. Bob was loyal to the friends that supported him like he was loyal to his wife and his company. If Pease was your friend, you had a friend for life. I learned that he would often stopoff at Jim Williams' house in Palo Alto on his way home. Despite Jim working for a competitor, he was

still a friend and Pease was loyal to the end, dying as he left Jim's remembrance.

Bob also had a unique interview style, Rather than try to stump you with something he had been working on for three years, he would ask "Whats 12 times 13?" If you added 12 to a gross to get 156 he beamed with delight. He was more concerned with your thinking process than any arcane knowledge you committed to memory.



Here Pease is explaining the fine points of measuring amplifier settling time. Bob and Paul Grohe both had an interest in amplifier setting time. This was coherent with Pease's love of the time domain. Unlike IC designers that would only think and communicate in the frequency domain, Pease understood that most of us start with oscilloscopes, not network analyzers.

I called a settling time summit and invited the select few engineers who loved the subject.

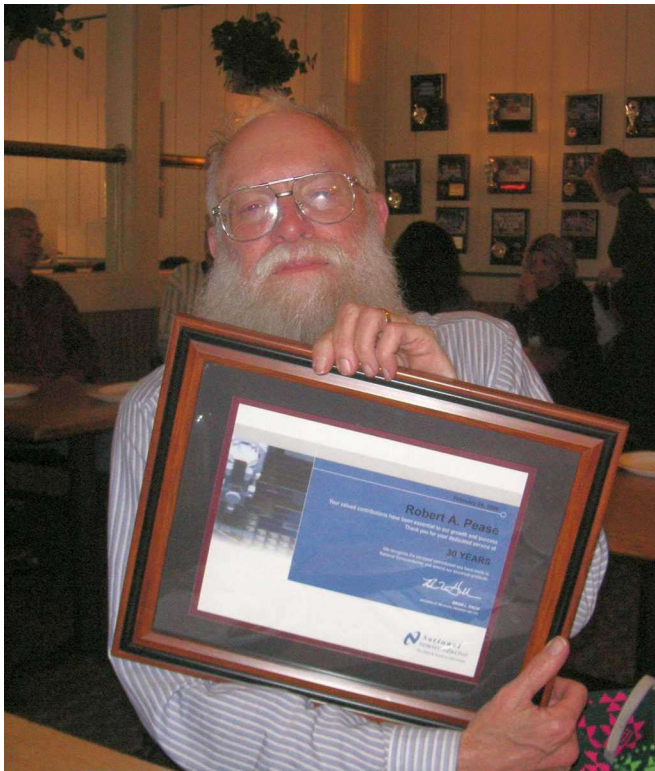


Here are the attendees for the settling time soiree, Barry Harvey then at Intersil, Jim Williams from Linear Tech, Bob Pease, and Paul Grohe. When it comes to intractable problems, analog engineers stick together. I asked Barry and Jim if they would get in trouble for "consorting with the enemy". They both scoffed, and their attitude was clear. No, they would not discuss product plans or design secrets. But having all the analog companies agree on how to measure settling time would be good for the customers, who could then make fair comparisons. This was the honor, the decency, the integrity of analog engineering at its best. The customer came first. Harvey remarks, "There's no doubt that Bob was a craftsman in electronics. Pease didn't confuse it with art or just a job. The settling time effort was beyond our job requirements but like the rest of the settling time cohorts, Bob could not resist the beauty of this exercise."

Unlike some engineers, Pease was very sociable and really did love people. Here he is at the eFlea in August 2009 talking to Linear technology co-founder and CTO Bob Dobkin. Pease drove down from San Francisco to hang out with his fellow tech types. He brought some of his books to peddle, but was there more for the camaraderie. He came to the eFlea breakfast

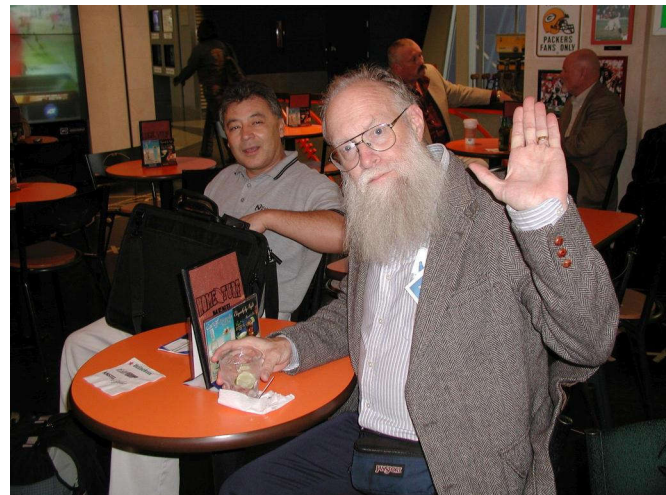


afterward, a treat for all my friends. You can see Bob's book about avoiding accidents on the table. An irony, since he died in an auto accident. It is thought he had a stroke as he descended the steep hill at Jim Williams' remembrance.



As a loyal employee, he was heavily invested in making National Semiconductor products and people successful. Here he holds a plaque for 30 years of service. Although he slowed down a

bit toward the end, he never left the company he so loved. While he might be shocked with the Texas Instruments sign out front of the former National Semiconductor facility in Santa Clara today, he was delighted to see that National got bought by people who were fully committed to analog, and who shared his passion for pleasing customers. Joe Desposito, his editor at Electronic Design magazine noted, "Bob was unrivaled as a columnist in this industry. Though he was certainly an analog guru who could write about the nuances of a very difficult subject area, he also talked about everyday (and not so everyday) life situations."



So goodbye Bob, friend, confidant, and analog genius. I have your poster in my lab, and I think of you every day. Pease did groundbreaking work developing concepts like laying out chips along a thermal centroid, and improving yields. He was even more amazing for the friends he cultivated and cared for, like Marcello Salvatierra, seen here with Bob while on the road with the analog seminar. Salvatierra reminisces, "I went around the world with Bob on the Analog Seminar. Between lectures visits we always took the road less traveled. Pease could converse about any subject and make sense. He loved to read, his suitcase was full of books. Bob Pease really understood analog

circuits and he unselfishly shared that knowledge. He was a great teacher. I learned so much from him, not only about semiconductor physics, but about life itself." Bob's love of teaching was demonstrated when he attended the annual Analog Aficionado party with fellow engineers and downed a few beers. He could keep us rapt with his stories, both technical and otherwise, all night long.

Pease was the most remarkable engineer I have ever met. He had the MIT degree and all the theory and math. So that was the theoretical, the Platonic side. But he also loved the lab and real-world circuits and manufacturing problems, so he also had an Aristotelian side. Like the scientific method, he balanced theory and experiment to advance the art of analog electronics. There are stories of a more cantankerous side of Bob, evident when he conversed with people with dumb questions. He never did it to me. The man I saw was polite and cordial with everyone, especially with the creative people in National's marketing and video production. Bob Pease was a true standout, the gentleman genius.

Bob's friends remember:

Bob's son Ben Pease reports, "My mom is having the San Francisco house made ready to sell this summer; it's preternaturally clean. I noticed the other day the painters had carefully masked around dad's calculator-pad burglar alarm keyboard. I removed it along with about 100 feet of 12-volt wire and the big wooden box with his home-built burglar alarm, so there are fewer electrical mysteries for the new owners. I also removed a parallel set of low-voltage wires for piping the stereo to random monaural speakers all over the house. I saved the controls for a home-built metal detector that never worked, but a good example of his neater circuitry. I perused his boxes of

old balsa wood/tissue paper airplanes. There's a mix of gas and rubber-band powered models, plus a few built for show back before there was much in the way of plastic. I photographed a bit of his intricate, fragile construction, seeing daylight for the first time in years. I found many archaeological clues as to his existence, but more so I find myself living some of his patterns, and strengths."

Ben continues, "Hanging in the shadows of mom's almost-finished basement was a ring of keys. There were one or two old-fashioned church keys and a bunch of filing cabinet and padlock keys on a coat hanger wire loop. This is a collection of keys for locks long gone. It brought to mind growing up. When my brother was a baby, dad made us either a rattle or a pacifier ring. He used wire and assorted screw-on tops for probes and plugs. Colorful brown and green plastic parts that rattled just like the store-bought rattles you might buy in a kid store. The cobbler's children have weird toys and good memories."

Bob's widow Nancy reflects, "Bob was a man with a great many aptitudes and interests, but I think analog always came first. I credit him with encouraging me to be me. He bought me the house in Truro [MA] that belonged to my great-grandfather's sister, where I live now. The San Francisco house is empty now and will be on the market in a few weeks. We never spent summers in Truro, but rented it out instead. We came in the spring, fall, and winter and I spent a lot of time here when he was off on his lecture tours."

Nancy concludes, "Oh and one last thing, when I went back to San Francisco on the 8th of May to finish packing for the movers, I, along with Ben and Jon and Amelia (the world's smartest granddaughter), installed Bob's ashes in the

columbarium in the north tower of Grace Cathedral. Some day mine will be next to his. But right now I have 200 or so Xerox boxes to unpack!"

Len Sherman, staff scientist at Maxim Integrated Products recalls, "I asked Bob a lot of questions when I was at National. When I went to him it was like drinking from a fire hose. He would explain, rapidly scribbling on pieces of paper. While he was talking I would nod, but not really understand much of what he was saying. After he finished, I would gather up all the bits he wrote down and go back to my desk, lay them out, and try to piece it all together. Amazingly that worked most of the time - I'd 'get it' about a hour later."

Sherman continues, "The Pease moment most memorable for me occurred a year after I got to NSC. I had been there long enough to be OK'd to give part of a presentation to Kodak. I think it was on the ADC0820 because I'd just finished the data sheet. We had a dry run in front of many engineers, plus sales guys and other interested parties. The was my first presentation of any consequence. I'm halfway through when I get a combative comment from someone in the audience saying that I was wrong. I was pretty sure I was right, it was something about ratiometric measurements and ADCs (analog to digital converters), but I wasn't presenting the best defense. Pease was there. He waited a bit while I stumbled, and then said out loud 'He's right', referring to me. That was the end of the argument. No more zingers for the rest of the talk."

Alan Martin, applications manager at Texas Instruments and member of group technical staff observes, "The first stage of archiving Pease was not so bad, just deal with clearing and sorting his Building-C cubicle. It took a week because I read each and every page and

sorted them appropriately. The pages that were personal emails to customers and associates are real gems. His devilish sense of humor is greatly toned down in the Pease Porridge columns that were meant for general consumption. In one-on-one communications he did not hold back. The cleanup of his old building-D office resulted about in three boxes of material worth saving. Then came the phone call from Nancy about the storage lockers of other 'stuff'. There were 500 banker boxes of mixed paper, breadboards, test fixtures, and ICs of unknown heritage or pedigree. There were a few other volunteers but after about 100 boxes, enthusiasm waned, and the sorting project stalled. Then last summer we managed to get the remaining items from the basement of Bob and Nancy's house in San Francisco. This lot has some interesting artifacts. Many of the breadboards and fixtures will be photographed and posted for public review. These creations are generally fragile and without labeling or documentation. By the way, we all owe a big thank-you to Texas Instruments for providing us the time and secure space for the archival process.

Don Tuite, retired power and analog editor of Electronic Design magazine remembers, "Bob and I had more conversations about Ethiopian cuisine than about technology. I suspect he saved his strong opinions for people he knew well, or conversely, for the distancing that comes with writing for a publication. It was hard to get Bob's highly-opinionated side to appear in more social situations. I remember the time my wife arranged to give Bob a demo ride in a Tesla Roadster, which was then still in pre-production. We rendezvoused at Buck's restaurant, and he and Vicky took off up Woodside Road into the twisties. They got back 20 minutes later, and Bob, who could go on at length about vehicular safety and design (he wrote a whole book about it), was politely

complementary about the car. Perhaps he was being chivalrous. Or perhaps test-driver Vicky had scared the daylights out of him."

Andy Aronson, producer/director at TI Studios in Silicon Valley remarks, "I still have his poster hanging in my cube at Texas Instruments. I miss the guy every day; and I miss the good times and interesting content we created during the 'Bob Pease Show'. I maintain that those episodes were, and still are, some of the best educational content any semiconductor company has ever put out. They were a unique combination of education, quirkiness, irreverence, and fun. To this day, we still get comments from Pease fans via the YouTube accounts where the Pease shows are posted. The comments come from all over the world and exemplify the connection Bob had with his fellow engineers."

Aronson continues, "I remember all those times Bob would come into the studio carrying bags and boxes of slides, air-ball prototypes and other props. Many times he was completely exhausted from the previous day's flight from India or Nepal or Europe. I'd bring him some coffee when he arrived to the studio all knackered, he'd thank me and get busy on the slides. It worked. Given a topic, Bob was a genius at assembling a show in about 20 minutes. We had a camera hanging from the studio grid that captured his slides and his 'live' drawing on the slides when he wanted to add an idea or two. The camera was affectionately known as 'Bob's chicken-scratch camera'. Not using PowerPoint added about two days of post-production time. It was worth every minute. During the set up of *What's All this Signal Current Stuff, Anyhow*, Bob was watching the crew go up and down the ladder to adjust the lighting. Bob liked the ladder and insisted we leave it as-is on set so that he could come down the ladder during the opening of the show, a grand entrance as it were."

Joe Sousa, curator of the Philbrick Archive corrects, "I don't think he designed with tubes very much. He did tell me that he was the product engineer for the SK2-V tube op-amp and I own some units with serial number under 100 that Bob worked on. As far as I know, Bob's first op-amp design was solid state. Perhaps it was the P85 solid state op-amp module. He certainly had no problem reusing circuits that worked, often improving them. Pease did not seem to suffer from NIH (not invented here)."

Figures 5, 6, and 7 credit Fran Hoffart. Figure 8 credit Alan Martin, Figures 11 and 15 edit credit Andy Aronson. Figures 10 and 16 credit unknown.

