

Stormy Weather By Chuck Greenslit

One of my first assignments at Bendix Radio in 1948 was design work on a Cloud Base and Top radar. Eventually this led to my being invited to co-author a paper with a Signal Corps engineer to be presented at a weather radar conference in Montreal in the fall of 1950. While at the conference I listened with interest to a paper presented by Frank White of the Air Transport Association. He speculated on the use of radar in civil aircraft to detect and warn the pilot of heavy weather, particularly thunderstorms, that would be in his flight path. Another Bendix employee, Bob Daniels, a salesman for Bendix avionics products, also heard the talk, and both of us reported the gist of the idea to the management at Bendix Radio. Since Bendix was a leading supplier of aviation electronic equipment in the world and also one of the major designers of radar equipment for the military producing a radar for commercial aircraft seemed to be a natural for us.

The upshot of the seed that we planted was an assignment I received personally to study the requirement and possible solution in my "spare time". Because I was interested, I did find considerable time to devote to this unofficial project. Nor was Bendix the only company to show interest. RCA with United Airlines was studying the problem and were publicly touting C band (5400 mc.) as being the optimum frequency for a weather radar. My studies favored X band (9300 mc.) with the key issues being distortion of the returns at X band due to attenuation versus better detection capability and resolution at X band with a limited antenna diameter (22 inches for a DC-6). Additionally, X-band components were readily available and cheap due to the extensive use of that band by the military thus offering the potential for price and size advantage for the equipment. A very lively debate on the subject of the best frequency ensued and along the line I got the nickname of X-Band Charley.

Unfortunately for Bendix, the Airlines Engineering Committee was swayed by the UAL-RCA arguments and developed the airline industry specifications around C band. My proposal for an X-band system went to Bendix management in March of 1953 and while they were pondering the problem a remarkable opportunity for testing and comparison arose. A Captain Taylor, USN, who commanded the Patuxent Naval Air Station was very much interested in commercial weather radar and was an X-band proponent. He volunteered the use of his personal aircraft, a DC-4 with an X-band APS-42 radar installed. RCA-UAL had outfitted a DC-3 which was based in Denver with a prototype C band system and they agreed to participate in a side-by-side test in the thunderstorms that formed almost daily on the eastern slope of the Rockies. We set a date within a week to fly to Denver with Captain Taylor and his crew and then spent a couple of hectic days and nights designing and installing an iso-echo contour circuit for the APS-42. Such a circuit simply chopped a hole in the solid returns from rain when the intensity of return reached a set level.

Somehow we got everything done and tested and I went on ahead of our entourage to find accommodations and set up schedules with RCA-UAL. Believe it or not, finding a motel room with both a telephone and a bathroom in the room (required for conversion to a darkroom) was not easy in Denver at that time but everything was in readiness when the DC-4 arrived the next day. We didn't have long to wait. A day later there were violent thunderstorms in the area and

the two planes took off flying parallel and in radio contact to synchronize pictures taken of the radar scopes. It was a rough ride and exciting when the planes would lose visual contact with each other in the clouds but the equipment in both planes worked well and we got lots of good pictures. One of my vivid memories of that flight was Art McComas seated on the floor opposite the radio rack with a camera attached to a radar scope taking pictures while trying to hold on to anything fixed. Art was not a happy flier and I always admired him for going up with us on that adventure. A good part of that night was spent developing and printing. The next morning we met with RCA-UAL to compare and exchange pictures. As one might have predicted the X band had superior definition but with some slight distortions. Obviously a radar at either frequency would meet the operational need although both sides claimed victory for their position.

Back at Bendix Radio, management decisions were promptly forthcoming. Despite the official C-band sanction by the Airlines Engineering Committee, Ed Foster and Dick Abel who were the Bendix decision makers decided to back my X-band proposal. They also decided not to go through the corporate approval procedure for new product development but to do the job quickly out of division funds. I was given six months and \$250,000 to do the design, have the factory tooled for production and build four prototypes to loan to customers as demonstrators. In addition to the basic radar, a version that was compatible with X-band military beacons was to be designed to give a navigational capability.

Fortunately, our design team had worked together for five or six years and there was little lost motion. In addition to having overall coordination responsibilities I worked on the transmitter unit with Grogan Shelor. Ken Molz and Bill Lambdin did the receiver and power supplies, Art McComas the indicator, Steve Ellen the antenna stabilization circuitry and Ed Hawkins did the mechanical design and layout. The Bendix Eclipse-Pioneer Division contributed the antenna drive unit, and the radio frequency components were subcontracted to Airtron and their talented designer, Tor Anderson. Drafting was assigned to Phil Huss and his team including Jimmy Rosenberger.

There were a few problems along the way such as coordinating aircraft wiring and rigid waveguide installations that would accommodate either the Bendix or RCA radars. The job was, however, completed on time and within cost and by June of 1954 we had made our press release and were demonstrating our product to the airlines using a company DC-3. Grogan Shelor and I were the chief demonstrators and spent many a week touring the country. Bendix allocated another \$29,000 for our sales efforts.

The Bendix sales department had estimated potential sales of only 300 radars to those airlines flying in thunderstorm country. Our first production release of fifty sets was sold out in no time with an unexpected market opening up for corporate aircraft. Arthur Godfrey had one of our radar sets on his DC-3 and was a vocal booster of weather radar. During this period the airlines were busy evaluating and letting orders. It was becoming obvious, particularly after the government made installation of weather radar mandatory for commercial aircraft, that we had a hit on our hands and more engineering money was allocated. \$90,000 was forthcoming to design a C-band version of our radar so that we could meet the needs of customers who favored that frequency. The original design of the power supplies for the Bendix system was very conservative and we did a redesign of one of the two full ATR units (the same as RCA) mounted

in the radio rack and got it down to a half ATR thus achieving our claimed advantage of smaller size. New indicators were also developed using "bright" tubes to give a better display in daylight. Fortunately our systems concept and layout was such that individual boxes could be replaced with improved versions while still maintaining the integrity of other system units.

One interesting evaluation took place at the United Airlines base in San Francisco where the RCA and Bendix C-band systems were compared. Apparently the San Francisco people were not aware of the close association between UAL and RCA and declared Bendix the winner. Admiral Bill Cleaves, a Bendix executive, had a big victory party for those of us involved but our celebrations didn't last long. UAL headquarters in Chicago reversed the decision and RCA got the UAL contract as expected.

By the end of 1955 the designs had stabilized and the factory was busy turning out radars. Responsibility for follow-up and future engineering was transferred to the Avionics design section and my group of "government" radar engineers took on new projects. The weather radar continued to be a major Bendix product dominating the market. RCA eventually bowed out but Collins Radio came up with a product to give Bendix some competition.

Chuck Greenslit (written circa 1987)

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