

# THE HALLICRAFTERS SX-28 THE CLASSIC SHORTWAVE RECEIVER

John Bryant

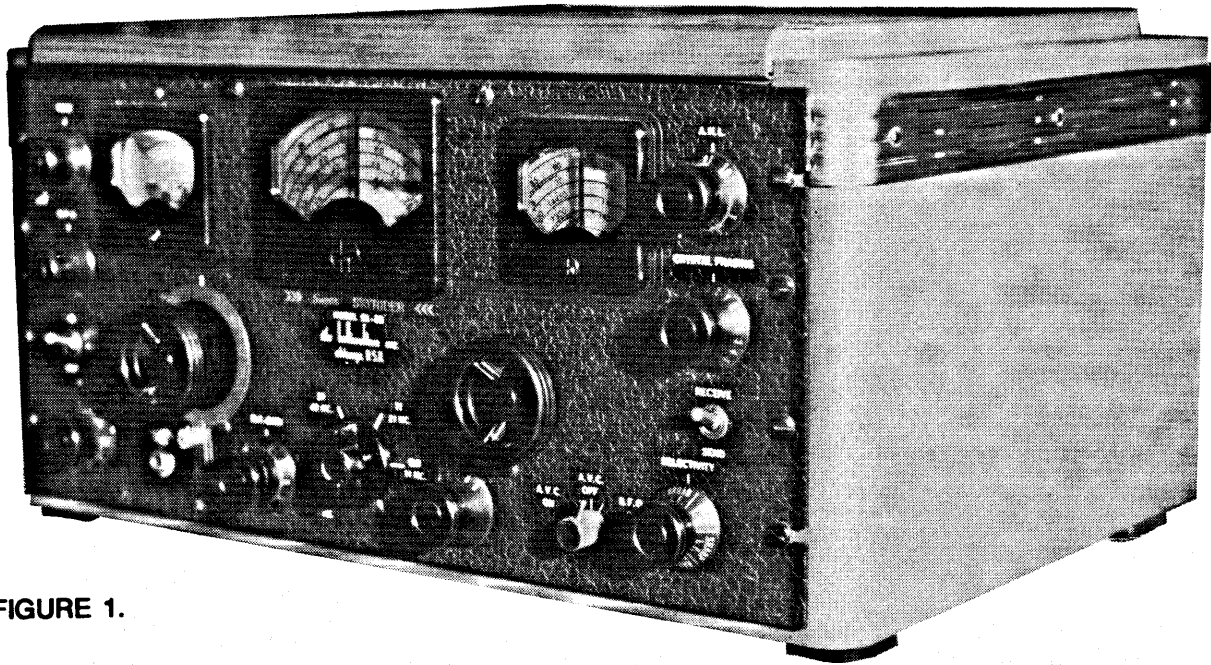
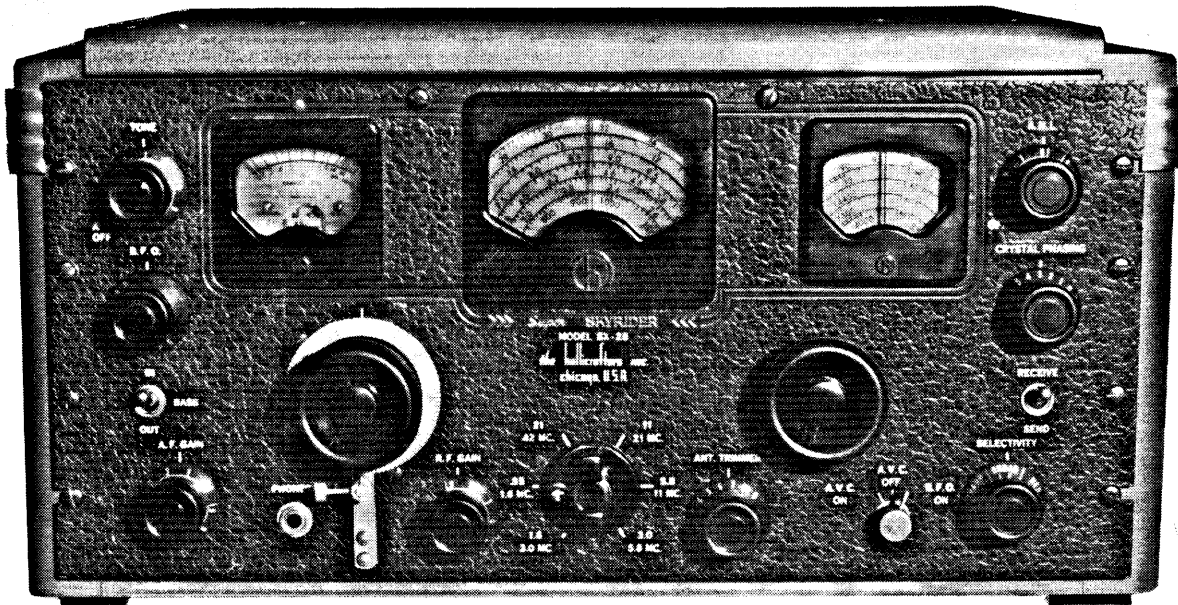


FIGURE 1.

Few products of our technological age become recognized as true classics of design. By look, styling, technical excellence and configuration they evoke an entire era. In the automotive world, the open Mercedes touring cars of the late 30's, the 1955 and 1957 Chevrolets and the 1957 Thunderbird define the meaning of "classic" automotive design for their eras.

In the world of tube-era shortwave receivers many aficionados would argue that there is only one true classic receiver: the SX-28 Super Skyrider by Hallicrafters. The SX-28 cabinet and front panel are superb examples of late 1930's Art Deco design. The circuitry is equally the epitome of state-of-the-art, spare no cost, communications receiver design at the very beginning of WWII. At the time of its introduction in 1940, the SX-28 was the largest and heaviest mass produced communications receiver ever built. The major competitors of the SX-28 in 1940 were variants of the long-in-the-tooth National HRO "Senior" first introduced in 1935 and the Hammarlund SP-200 (BC-779) Super-Pro series, produced from 1939-1945.

The SX-28 is a 15 tube, single conversion, super heterodyne receiver that provides continuous coverage from 550 kHz to 42 MHz in six bands. It is 19 1/2" wide (plus cabinet), 10" high, 15" deep and weighs 75 lbs., including cabinet. Internally, the receiver provides a two stage RF amplifier/preselector. Only one stage is engaged on the lower two bands (.55 MHz - 1.6 MHz and 1.6 MHz to 3.0 MHz.) Both RF stages are used above 3.0 MHz to boost sensitivity and image rejection. There are six separate IF filter combinations selectable from the front panel - three tuned L-C circuits for AM reception and three phased crystal filter positions primarily for CW reception. The front panel contains AF and RF Gain controls, a BFO, a very effective Tone control and a Bass Boost control that operates like those found on modern stereos. (Wonderful!) The panel also contains a switchable AVC Control and adjustable and effective Noise Blanker which uses a Lamb circuit. The six-position band switch and those two wonderful large bakelite 'steering wheel' tuning knobs that drive the tuning capacitors through a silken smooth system of brass gears and flywheels.



## AT THE DIALS: GETTING TO KNOW THE SX-28

As you settle in front of the SX-28, the first impression is of visual delight. Certainly, it is the best looking receiver produced prior to the Raymond Loewy designed SX-42, introduced in 1946. It is a real pleasure to sit at the SX-28 hour by hour DXing or SWLing and just LOOK at the front panel. As you examine the receiver more closely, you begin to realize that this radio was designed by and for people who were VERY serious about their radios. All of the lettering and the leatherette finish of the front panel is embossed right into the 1/8" thick steel! This attention to detail continued throughout the design of the panel. The smaller knobs carry wide numbered skirts, allowing accurate pre-setting of the various controls; handy and beautifully executed.

What attracts most of us to the SX-28 are the giant spoked (steering wheel) main dial and bandspread knobs. They have been designed to fit the hand well during long hours of use. Giving either of these knobs a spin is a sensual thrill. Each gear train has just the right amount of inertia. Today, after 50 years, there is ZERO "play" or backlash in the tuning system. Those knobs and the machinery behind them should have received a gold medal for industrial design and mechanical engineering long ago. The only American receiver that approaches the feel of an SX-28 is one designed to replace it in government service: the Hammarlund SP-600.

It is extraordinarily easy to tune the SX-28 to a desired frequency or to determine the frequency of an unknown station. This critical ability for any serious receiver is greatly aided by three design innovations that first appeared on the SX-28 [1]. The first is a main dial tuning index (zero to 100) located as a skirt on the main (left-hand) tuning knob. Moving from one end of the dial to the other involves 15 turns. The main dial logging scale of zero to 100 is there for 1500 individual loggable increments. The bandspread dial also has a 0 to 100 logging scale. Each scale may easily be interpolated to the one and two-thirds points (e.g. 48.33.)

The second design innovation first used on the SX-28 is the main dial lock. This mechanism, seen as the vertical bar directly below the main knob, pinches the metal knob skirt very firmly, locking the skirt and the main tuning capacitor.

The final innovation for frequency read-out is the index line itself in both the main dial and bandspread windows. The SX-28 was the first receiver (and one of the few ever) to provide a three-dimensional "blade" index to aid in dial reading. This 1/32" wide by 1/4" deep vertical blade assures the operator that he is looking at the dial markings STRAIGHT ON.

Combining the two logging scales, the dial lock and the blade index, it is possible to return to any previously dialed frequency instantly and accurately. For instance, if you wish to return to an unknown signal logged in the area around 4 MHz, you flip the bandswitch to band #3 (3.0 to 5.8 MHz) and spin the main dial to the region of 4 MHz. Then, you check your log book and find the index location of this unknown signal-when you first logged it; you jotted down of "48.33/35." You move the main dial to read 48.3 on the skirt index and LOCK it in place. You rotate the bandspread to 35 and THERE is your unknown signal. It is easily possible to reverse the process and develop a graph for a particular band of frequencies. Using this method, the operator locks the main knob at a certain number and reads the zero to 100 bandspread logging scale. A homemade graph then converts the logging scale number to kHz. This method allows near single kilohertz resolution on all of the Tropical Bands!


**8 Years Ago!**

**S-17 - A Good Receiver!**  
 When we first made the S-17 eight years ago it was a good communications receiver and we knew it contained every possible improvement known to our engineers. Eight years is a long time... many improvements have been made, our laboratories have been constantly engaged in research for better communications reception. Our work has been rewarded by your confidence in Hallicrafters communications equipment.

**the hallicrafters co.**  
 CHICAGO, U. S. A.  
*Keep Communications Open*

**The SX-28... A Good Receiver NOW...**  
 Incorporating many years of engineering research the SX-28 has had world wide acceptance. The fifteen tubes, six bands with a frequency range of from 550 kc. to 42 mc. give a new high in quality performance.

S-1  
S-2  
S-3  
S-4  
S-5  
S-6  
S-7  
S-8  
S-9  
S-10  
S-11  
S-12  
S-14  
S-15  
S-16  
S-17  
S-18  
S-19R  
S-20R  
S-21  
S-22  
SX-23  
SX-24  
SX-25  
S-27  
SX-28



**FIGURE 4.**  
 These advertisements are reproduced through the courtesy of QST magazine.

**SX-17**  
**SUPER SKYRIDER**

With complete coverage from 5 meters to the top of the broadcast band, fractional microvolt sensitivity on all amateur bands, variable selectivity that ranges from broad high fidelity to better than 1 kc with crystal filter in circuit, 2 stages of Pre-Selection and a built-in Automatic Noise Limiter for cleaner reception on the higher frequencies, the SX-17 provides the amateur with a quality and versatility of performance that is difficult to surpass.

All this at its moderate cost, explains the world-wide preference of the amateur radio fraternity for the SX-17. Your Hallicrafters dealer will gladly show you the SX-17, or complete description will be sent you on request.

**the hallicrafters inc.**  
 2609 Indiana Avenue, Chicago, U. S. A. Cable Address: HALLICRAFT, Chicago

**WORLD'S LARGEST BUILDERS OF AMATEUR COMMUNICATIONS EQUIPMENT**



**FIGURE 3.**

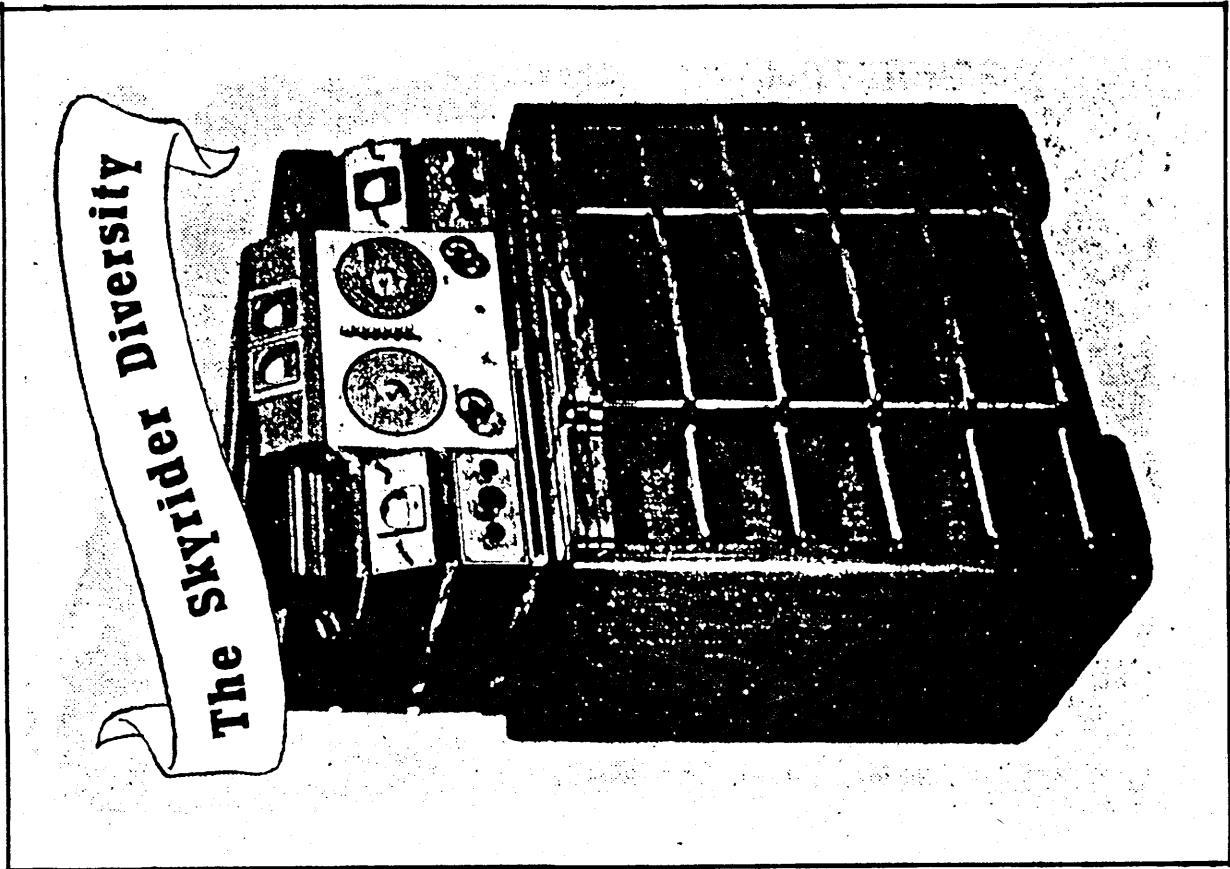
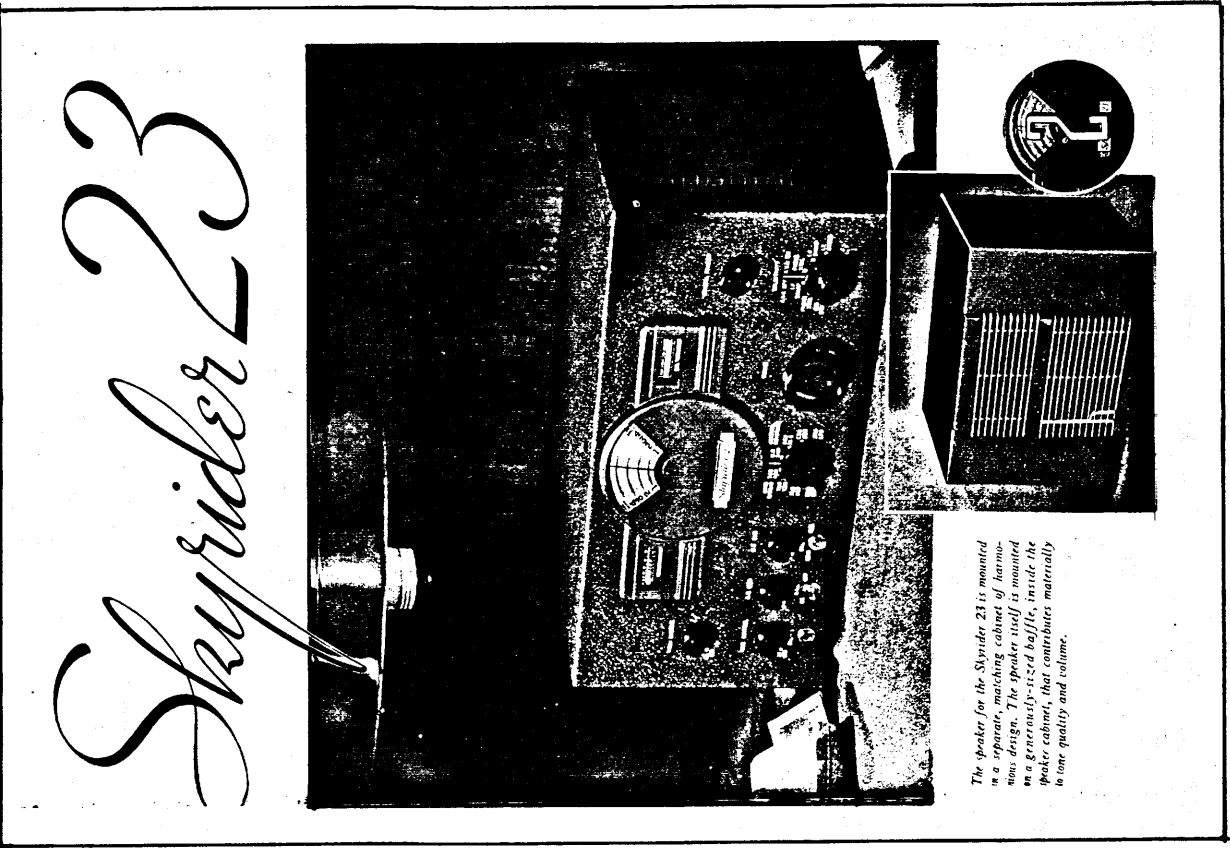


FIGURE 5.



*The speaker for the Sky Rider 23 is mounted in a separate, matching cabinet of harmonious design. The speaker itself is mounted in a generously-sized baffle, inside the speaker cabinet, that contributes materially to tone quality and volume.*

FIGURE 6.

These advertisements are reproduced through the courtesy of GST magazine.

## THE SX-28 SUPER SKYRIDER: Lineage [2]

The Hallicrafters company, led by Bill Halligan, burst on the communications scene in the mid-1930's. The other established manufacturers, most notably National and Hammarlund, had been around for almost a generation, first as component manufacturers and then as manufacturers of major communications receivers. Each of these companies concentrated on producing a single 'top of the line' receiver and refining it over a period of years. Bill Halligan developed a completely different design and marketing concept. Hallicrafters prospered based on the idea of creating completely new receiver models in rapid succession, each incorporating the latest engineering developments. Early on, the company also began offering a wide range of models and prices to enable the radio enthusiast to obtain the best receiver he could afford.

The rapid research and product development of Hallicrafters in the 1930's is stunning even from the perspective of the change-oriented 1990's. The advertisement from June 1942 *Radio* magazine (Figure 4) indicates that even Hallicrafters was aware of how far and how quickly they came in the 1930's.

Bill Halligan introduced the first Hallicrafters receiver in 1933. It was a regenerative TRF receiver called the Skyrider and it became known later as the S-1. In the next year, the S-2 and S-3 were developed and marketed. Each was a TRF set and each was called the 'Skyrider'. In late 1934, Hallicrafters introduced the S-4, one of the first mass produced superhetrodyne communications receivers. The S-5, S-6 and S-7 followed in rapid succession. Each was a superhetrodyne circuit and each was called the 'Super Skyrider'. In 1936, specialized models began to proliferate, but the top-of-the-line receiver being marketed at any particular point continued to be called the 'Super Skyrider'. The 1936 Super Skyriders were the S/SX-9. The S/SX-9 was followed in that same year by the S/SX-16 and the S/SX-17, each also known as the Super Skyriders. These latter receivers, especially the models with crystal filters and therefore carrying the 'x' in their title, remained as top of the line for several years. [3]

The SX-16 and its immediate upgrade the SX-17, Super Skyrider (Figure 3) are worthy of brief discussion, for these were nearly modern major communications receivers. The SX-17 had 13 tubes, covered .54 to 61 MHz in six bands, had bandspread, a BFO, S-meter, and a switchable automatic noise limiter. The selectable IF band width was based on L-C and phased crystal circuits. The SX-16/17 also sported entirely new and very modern late Art Deco exterior styling. The SX-16/17 marks the first introduction of the large bakelite 'steering wheel' tuning knobs, rounded front corners of the cabinet and the decorative chrome trim pieces on each end of the receiver. These receivers also mark the first introduction of the 'half moon' escutcheon. This beautiful escutcheon was used for S-meters and band spread dial openings on almost every major Hallicrafters receiver from the SX-16 to the end of WWII. Several authors, including me, have postulated that Hallicrafters must have retained a professional industrial designer to provide the massive aesthetic upgrade represented by these receivers. This was not the case. The motivating force behind these and most other improvements in the appearance of Hallicrafters products was Bill Halligan himself. Unlike the other radio manufacturing barons of the day, Mr. Halligan had a career-long commitment to creating visually pleasing radio equipment. He reasoned that many radio buffs would like to move their gear from the garage/shack into the house.

The detailed design of the visual upgrades for the SX-16/17 was probably done by J. L. A. McLaughlin. Mr. McLaughlin was an artist/designer and a self-taught RF engineer. Mr. Halligan hired him away from Collins Radio, where he had been doing some product styling. He was hired by Mr. Halligan in 1936-37 to further develop his diversity receiver brainchild. Under the guidance of Mr. Halligan, this McLaughlin dream eventually became the legendary Hallicrafters Dual Diversity DD-1 receiver (Figure 5) [4]. With the stunningly beautiful DD-1 as evidence, most authorities would wager that Mr. McLaughlin was a fully educated product designer as well as a professional RF engineer.

In March 1939, Hallicrafters introduced what was intended to be the "ideal communications receiver," the SX-23. This receiver had started life as an unofficial "ideal but impractical" receiver put together by several Hallicrafters engineers in the design lab. [5] Mr. J. L. A. McLaughlin was responsible for the styling of the SX-23. (Figure 6) It was the last receiver that he designed for Hallicrafters. The SX-23 required several unique manufacturing processes and had a very unusual dial and front panel. The SX-23 proved too costly to produce and went out of production after only two runs of 500 sets each. [6]

## THE SX-28 SUPER SKYRIDER: Design Perspectives

By the time that the SX-23 was introduced, both Bob Samuelson and Ferd Schor had joined Hallicrafters. Mr. Samuelson was originally hired away from Collins to design transmitters. Mr. Schor was hired as Lead Receiver Engineer from Ultramar Manufacturing Company where he had designed several receivers of outstanding performance. After being with the company about two years, Mr. Samuelson was made Chief Engineer of Hallicrafters. These two men along with RF engineer Fred Stromatt designed the SX-28. (Refer to Figure 7.)

Compare the case, control layout, knobs and dial escutcheons of the SX-28 to those of the SX-16/17. It is easy to see that the SX-28 design team abandoned the 'new direction' established by the SX-23 and returned to the extremely successful SX-16/17 as a jumping off point. The escutcheons, trim and cabinet design established by the SX-16 were followed quite closely in the SX-17, SX-18, S-19, S-20, S-21, S-22, S-24, S-25, S-26 and S-27.

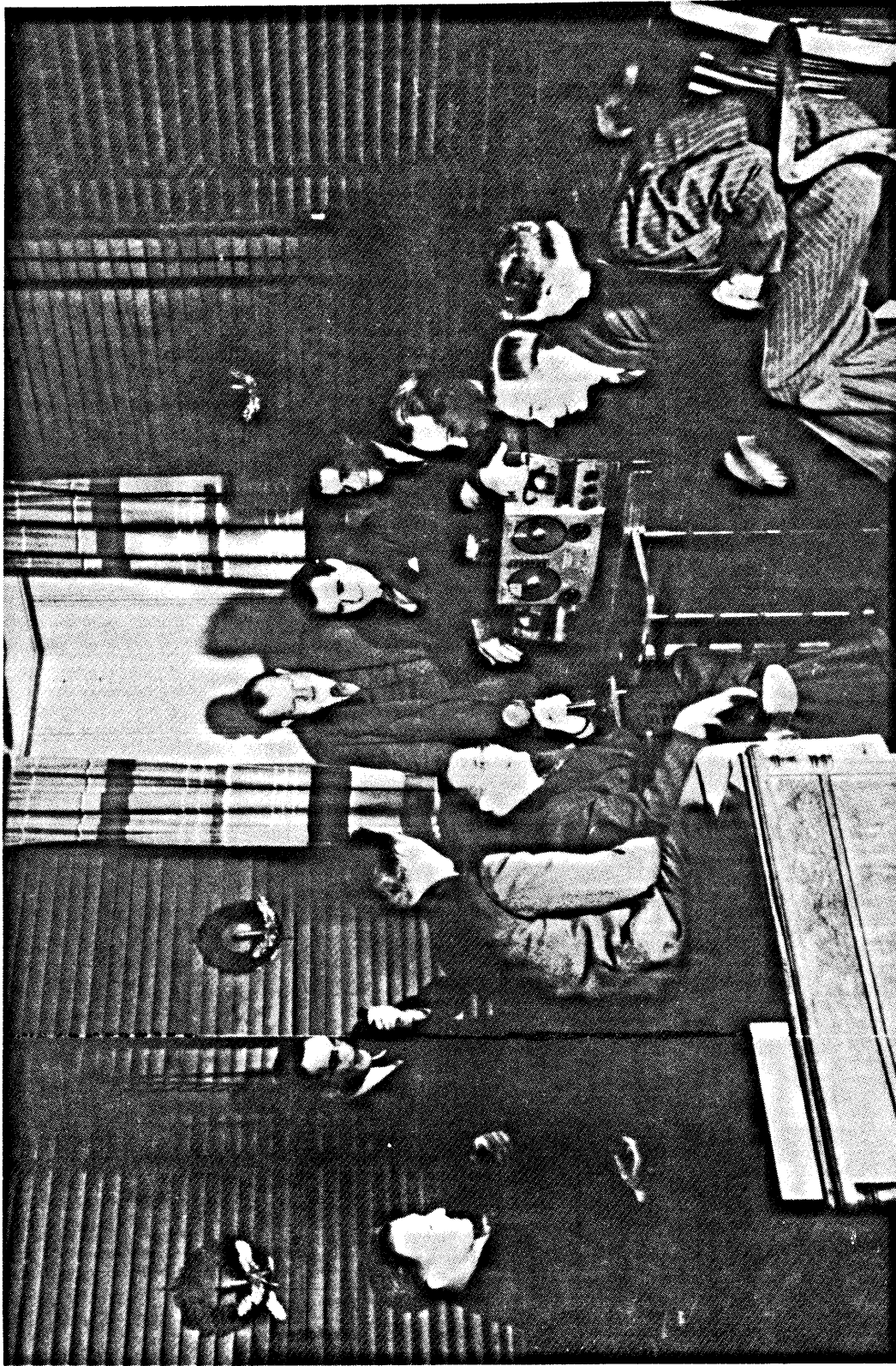


FIGURE 7. The Hallicrafters management team is shown in a photo from Christmas 1939 that was taken in Bill Halligan's office. From left to right: Fred Stromatt - SX-32 receiver engineer, Royal Higgins - Sales, Ed Corcoran - Purchasing, Bill Halligan - President, Loren Toogood - Production Engineer, Ray Durst - Vice President, Joe Frendries - Controller, Herb Hartley - Production Manager, Bob Samuelson - Chief Engineer, J.L.A. McLaughlin - DD-1 Engineer and Designer. Not shown: Ferd Schor - Lead Receiver Engineer. Photo courtesy of Dr. Robert Samuelson.

Unlike the previous 10 receiver designs, however, there were several departures in the exterior detailing and appearance of the SX-28. The 28 along with the S-27 were the first mass-produced Hallicrafters designed as rack-mounted receivers. The SX-28 designers also developed a beautiful full blown Art Deco metal case to accept the rack mount chassis. For the first time since the SX-16, the configuration of the dial and S-meter escutcheons was also modified. Although the new shapes are clear outgrowths of the SX-16/17 lineage, it again appears that the hand of a professional product designer was involved; again, this was NOT the case.

Bob Samuelson, now retired and living in Phoenix was kind enough to record the development of the SX-28 design for us:

*The time was ripe in late 1939 or early 1940 for a new 'Super Skyrider' to replace the SX-17. The war in Europe had started, and many new demands for off-the-shelf communication receivers were appearing. One example: the FCC had the responsibility of monitoring the air waves to track down and locate sources of radio signals (possibly of espionage nature), and planned to equip monitor vehicles for this purpose. Our UHF S-27 was already in the works, and covered the range 27-145 mc. and a shortwave/general coverage companion receiver was needed.*

*Ferd Schor and his other receiver engineers had already decided on circuit innovations and improvements on the SX-17, so we now embarked on the design of the SX-28. I injected myself into the process, by taking over the mechanical design. My college degree was BSc ME from the University of Minnesota in 1933 to which I had added some studies toward a MSc in EE. One of my innovations was to replace the earlier string drives for the two tuning dials with precision, anti-backlash gear drives. This now made possible the addition of the logging dial on the main tuning knob. I wanted the tuning dial to be behind the panel, but felt that use of separate metal escutcheons might lead to a tinny appearance - I got the idea of using a large black bakelite dial escutcheon to be a companion to the S-meter and bandsread dial escutcheons.*

*I had been thinking for some time about designing a good gearing arrangement for the SX-17, and had done some sketching. As electrical design proceeded with the SX-28, I laid out a gear assembly to fit. We made one sample laboriously in the shop and then turned the design over to Crowe Nameplate Co. to produce. (They already made our dials.)*

Almost all of the large magazine advertisements for the SX-28 carried a banner headline: "Designed to government specifications!" Before I contacted Bob Samuelson, I thought that maybe the U.S. military or the FCC might have put out a set of specifications for what became the SX-28. This might have been in the form of a "Request for Proposal" (RFP) as is the modern practice. My supposition is an example of the dangers that historians run when they infer too much! I was completely in error! Bob's answer to my query clarifies the issue:

### **"DESIGNED TO GOVERNMENT SPECIFICATIONS!"**

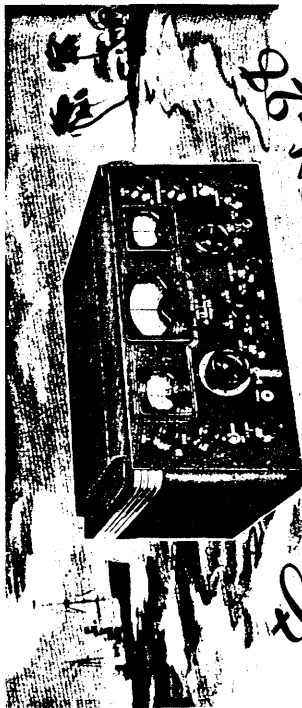
*By 1940, we had reviewed many government specs. for various radio and electronic equipments. We found that most of these had strong similarities in "standard paragraphs" which covered such things as choice and rating of parts, tolerances, moisture proofing, etc. We took it on ourselves to adopt all that applied, although I don't remember any actual "Specification for SX-28." However, the set was actually designed using gov't specs. that we felt did apply.*

*After building and testing our first engineering model, we build 10 more as a 'pilot run'. These were snapped up by the FCC, and we then proceeded with a longer production run.*

*One amusing experience had to do with the shipping container. We had been having some trouble with our sets being damaged in shipment, even [when using] wooden crates. We contacted a professional packing design company, who came up with a package for the SX-28 using corrugated cardboard! It had inner and outer boxes, with protective inserts at critical places. To test this out, we took our SX-28 (one of the first run) which had just passed our final test bench, packed it in the new package, and took it up to the 8 floor of our loft building, in the rear, to the top of the spiral set of wooden steps. We actually rolled this poor SX-28 in its box, end over end, down to the basement! Then took it back upstairs, unpacked it, and returned it to final test. Believe it or not, the set met all its performance specs; no change. There was one little dent in a crossbar in the top of the cabinet, but this was easily fixed.*

*The design of the cabinet simply grew as a suitable package to accept and protect the radio assembly itself; we didn't think of it as an artistic triumph; just part of the job. Bill Halligan was close to us, particularly in the final stages. He might have made suggestions regarding trim stripes, ventilation grilles, "feel" of the knobs etc. I can only say that we looked on the final package as "Form follows Function." [6]*

With the arrival of the SX-28, the Hallicrafters design team had produced the right radio at the right time: the leading state-of-the-art receiver at the beginning of WWII.



*the Cruise of our SX-28*

**Recently we received a letter from an owner praising the performance of an SX-28. The letter, five pages long, is too lengthy to re-print in its entirety so we are re-printing the paragraphs most interesting to communications performance.**

"This letter will deal with the voyage from San Francisco to the Philippines, then to the Far East namely Shanghai and Hong Kong and back to the Philippines then down through the inside passage from the Philippines down through the islands past Thursday Island then down the Australian coast inside the Great Barrier Reef to Newcastle. From Newcastle to Brisbane then almost due east across the Pacific until we approached Pitcairn Island when we turned about northeast and headed for the Canal, then from the Canal to New York with coast-wise ports enroute. Roughly, the total mileage for this trip was about 32,000 and involved a period of about six months.

"... for about 3 months the ship was in tropical weather, the radio room was very hot, all port holes and doors were open almost continuously day and night. The Hallicrafter SX-28 was exposed to the elements almost as if it were outside, much of the high tropical humidity penetrated the room where the SX-28 was operating.

"We traveled through tropical heat of 120° into the cold slashing gales of the China Sea and remained in extreme cold weather, then back down to the tropical heat again... most receivers are prone to develop all kinds of troubles in these varying climates... I was busy, at times, repairing other sets breaking down due to the humidity, but the SX-28 went merrily along its receptive way."

"... the SX-28 was almost continuously subject to vibration, one kind of vibration at one depth of load, another at another depth—increasing until the whole ship vibrates when the load was light. At times when receiving short wave the SX-28 was vibrating so that it was actually jiggling back and forth in short, quick jerks as the whole ship vibrated, yet no effect was noticeable on reception... I had all kinds of trouble with my regular equipment, yet the SX-28 ran the gauntlet unharmed and unaffected.

"... my listeners of whom I had a regular public at news times have remarked the program would fade out and sparks would flip a switch and back in it would come with a bang... the pay-off though is the code reception. With signals weak, static at Woodworth bargain counter proportions of jamming, and code signal interference the ANL circuit jumped into effect in an astounding way... one remarkable comparison was XSG Shanghai who comes in with a bang all over a wide space on the dial on the 36 meter band. He was right on top of WCC and would blot him out. A twist of ANL and in comes XSG, a flick of the crystal control and in comes WCC with a bang and out goes XSG.

"... In Shanghai I was offered \$350 in gold for my SX-28.

"I have opened receivers for repair of standard brands and found variable condensers covered with green whiskers from corrosion, coils broken in windings from salt corrosion, bus wires even eaten off inside insulation due to the same corrosion... so all in all I think it a high tribute to the Hallicrafter workmanship in this receiver that it has survived a period of two trips now and is still going strong."

FIGURE 8.



**Communications were PERFECT!**

Hallicrafters receivers and transmitters are making history in keeping communications open for the armed forces of the United Nations. We with we were at liberty to name places and dates but of course that is impossible just now. However, as soon as we can, we want to write the achievements of this equipment. We are as proud as though we had several thousand sons in the services. You can be assured we will continue our efforts until victory is final and complete. The SX-28 (illustrated) 15 tubes, 6 bands, 550 kc. to 42 mc. \$179.50.

**the hallicrafters co.**  
CHICAGO, U.S.A.  
*Keep Communications Open*

FIGURE 9.

These advertisements are reproduced through the courtesy of OST magazine.



## THE SX-28 IN WWII:

Figures 8 and 9 are typical advertisements from radio magazines during the war years and give some idea of the uses of the SX-28 just before and during WWII. Bob Samuelson believes the story told in Figure 10 to be true. Advertising of the era indicates that over 50,000 SX-28's and SX-28A's were produced from 1940 to 1947. As the major state-of-the-art receiver at the beginning of the war, the SX-28 saw service in every theater of operations. Its general coverage HF design and its weight probably dictated that most uses were in more or less fixed base communication. Even the ham station at Fort Monmouth, N. J., (Signal Corps headquarters) was equipped with SX-28's. [10]

One of the most interesting facets of the World War II uses of the SX-28 was related in a recent letter from Bob Samuelson. Bob refers to a one-time-only advertisement in *QST*, May 1941, for an RSC #1, "the complete radio receiving station: a rack mount/cabinet holding an S-22R, S-27B and an SX-28. This unit tuned continuously from "110 kc to 145 mc."(Figure 12.) Bob states: "I know that we sold a number of these units to government agencies. I suspect that the OSS, precursor of the CIA bought several. Bill Halligan was very good friends with one of the top men in the OSS - both had attended West Point." [11]

The outcome of World War II in the Pacific hinged on the performance of the aircraft carriers of the Japanese Navy and those of the U.S. Pacific Fleet. The Battle of the Coral Sea took place in May 1942 just east of New Guinea. This American victory halted the advance of the Japanese juggernaut at the cost of the loss of *USS Lexington* and heavy damage to the *USS Yorktown*. The damaged carrier was quickly repaired and joined the carriers *Enterprise* and *Hornet* at the pivotal battle of WWII in the Pacific: The Battle of Midway. This great American victory was accomplished entirely by the airmen flying from the three American carriers. The *USS Enterprise* went on to assist almost all of the battles of the Pacific, from Guadalcanal in 1942 to Iwo Jima in mid-1945.

Surely one of the most ringing testimonials for a piece of equipment ever written was received at Hallicrafters in late 1943. It was immediately reproduced in the Hallicrafters 'Tuner'.

WUP167 GOVT LG=CT WASHINGTON DC

NOV 3 1943 251P

TO THE MEN AND WOMEN OF  
HALLICRAFTER CO INC=

YOUR SX28 RECEIVER ON THE "USS ENTERPRISE" RECEIVED CONSTANT USE DURING THIS FAMOUS CARRIERS EXTENSIVE ACTIONS AGAINST THE JAPS IN THE SOUTH PACIFIC. TUNED TO RECEIVE MESSAGES FROM HER PLANES ON MISSION AND FROM FIGHTER PLANES PATROLLING THE FLEET YOUR RECEIVER EFFICIENTLY KEPT THE "ENTERPRISE" INFORMED OF THEIR ACTIVITIES. THIS INFORMATION WAS USUALLY TRANSLATED INTO ACTION AGAINST THE JAPS -- TO THEIR SUBSEQUENT SORROW AS THE "ENTERPRISES" RECORD OF 185 PLANES DESTROYED, 27 SHIPS SUNK AND 16 DAMAGES WILL ATTEST=

= E L COCHRANE

REAR ADMIRAL USN

CHIEF OF THE BUREAU OF SHIPS. [12]

At present, I have no information on the radio equipment aboard the other main battle carriers of the Pacific Fleet. Given the usual way that military equipment is acquired, it is fair to guess that all of the carriers were equipped with similar radio equipment. If such is the case, the SX-28 must be credited with playing a very significant role in the American victory in the war in the Pacific.

Finally, Ferd Schor wrote, "We had the production line going on the SX-28 and the SX-28A all during World War II and the services could not get enough of them. The reports I had from service men were excellent. Many of them took one home to use (at the close of WWII.) [13]

## THE SX-28 AND THE FCC:

During WWII, the primary responsibility for radio-oriented counter intelligence was given over to the Radio Intelligence Division of the FCC. The RID also had primary responsibility of guiding lost aircraft back to base, using their nationwide direction finding capabilities.

RID had about 300 radio personnel and operated twelve primary monitoring stations located strategically throughout the USA and its possessions.

The work of the RID was featured in a *QST* article published in late 1944 following a visit to the Allegan, Michigan monitoring station. This 200 acre facility housed both the RID and the FCC's Field Division Monitoring Station. There were two main monitoring rooms, the Cruising Room and the Intercept Room, and both were packed with SX-28's and S-27's. General use antennas included a 'wagon wheel' of eight rhombics, three Beverage antennas, a dozen folded dipoles and miscellaneous other antennas spread across the entire site.

The Cruising Room was the heart of the Monitoring Station (Figure 10) with six SX-28's and three operators scanning the bands constantly. The operators of all twelve stations were linked by dedicated teletype system. Within each station, the Cruising Room operators were also linked via an intercom to a remote site (also with SX-28's) where direction finding (DFing) was done using a rotatable Adcock array (Figure 11). By teletype coordinated DFing between several scattered Monitoring Stations, the RID could virtually pinpoint the location of a mystery transmitter or lost aircraft. In mid-1944, the Station Supervisor stated that they had never had to make a major repair on any of their SX-28's since their acquisition in 1941. They had been in day and night continuous service for more than three years.

Hallicrafters also developed a special selectable independent sideband version of the SX-28 for use by the FCC and possibly by the OSS. This unit, known as the SSR-202, was designed by Jim McLaughlin and had an additional IF channel. One of the two IF channels was aligned 5 kHz above the normal IF, one 5 kHz below. The incoming signal was split at the first detector and selectively sent down one of these channels. Each channel was highly selective and had a very sharp cut-off. If one sideband of the incoming signal was distorted, the operator threw a switch to select the other. The article states: "We predict that after the war, when full construction details can be given, this refinement will come into universal use in the stations of most hams." [8] the ideas developed in the SSR-202 version of the SX-28 did not reach the general use for another 40 years!



FIGURE 10. The Cruising Room

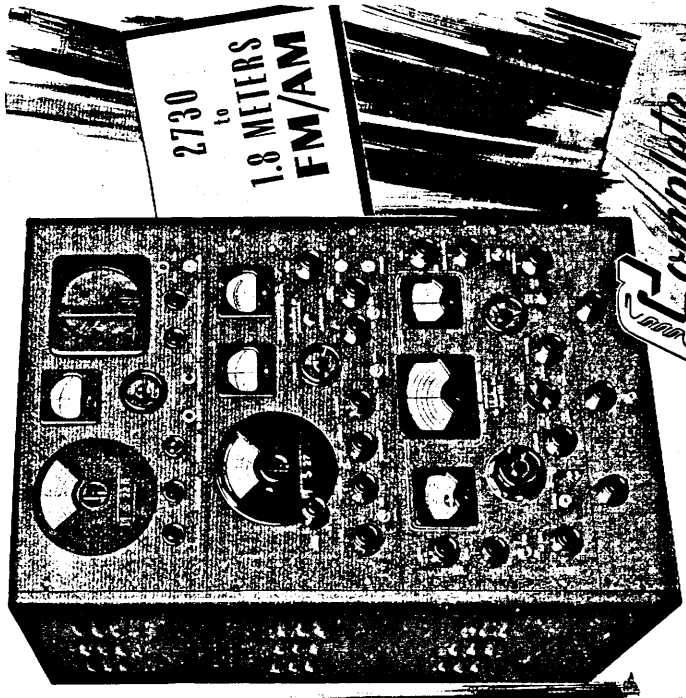
Photos courtesy of Dr. Robert Samuelson.



FIGURE 11. Adcock Array DFing Hut

FIGURE 10 and FIGURE 11:  
These figures are reproduced from an issue of *The Hallicrafters Tuner*, the internal company magazine. This issue was published in late 1944 or early 1945. The caption used was:

*Above right: Operators patrolling the ether use Hallicrafters SX-28 receivers which must operate unerringly 24 hours a day, month after month. One of our frequency standards may be seen in the photograph as well as an S-27 receiver. Below: Operator, within hut of Adcock direction finder, rotates large wheel directly under the H antenna while listening to signals from an unidentified station through his Hallicrafters SX-28 receiver.*



**Complete  
Radio Receiving Station**

Covers substantially everything in the radio spectrum. You can use one, two or all three units simultaneously through the separate antenna switch. Monitoring speaker connects to any one; in addition separate speakers can be connected as you wish. Headphone monitoring jack ties into output of any one of the three receivers. The only receiving unit made which tunes continuously from 1.82 to 2730 (165 mc to 110 kc). A few of its services are: time signals, coastal and ship telegraph and telephone, aircraft beacons, standard broadcast, relay broadcast, aviation, amateur, international short wave bands, police, government, press and educational channels, FM broadcast and relay bands with high fidelity audio for best FM reception. Is 20 1/2" wide, 30" high, 18" deep. Sells complete for \$450.00.

**the hallicrafters co.**  
CHICAGO, U. S. A.  
USED BY 33 GOVERNMENTS... SOLD IN 50 COUNTRIES

FIGURE 12.



**Panoramic RECEPTION!  
THE VISIBLE SPECTRUM  
OF RADIO FREQUENCIES**

Research and development engineering in the Hallicrafters laboratories goes constantly forward . . . keeping ahead of the fast moving pace of today's defense requirements for communications equipment.

Panoramic reception is only one of the many new developments Hallicrafters will be the first to introduce when short wave equipment is again available for civilian use.

**the hallicrafters co.**  
CHICAGO, U. S. A.  
*Keep Communications Open!*

FIGURE 13.

These advertisements are reproduced through the courtesy of CST magazine.

## THE SX-28 VARIATIONS

According to Ferd Schor, there is only a minor electrical difference between the SX-28 and the SX-28A. He wrote "The SX-28A is the same set except that the set used a molded RF coil form with mica trimmer attached and was cheaper to produce."

One legend currently around the radio hobby is that the front panel of the SX-28 said only "SX-28" whether it was the original or the "A" version. At best, this is only partly true. I have seen an SX-28A in Chuck Dachis' collection that has "SX-28A" stamped in the proper place on the front panel. There is also one in Mike O'Brian's collection and that of the Hammond Radio Museum.

Figure 13 is one of only two known advertisements showing the SX-28/S-35 combination. Today, the S-35 is one of the rarest Hallicrafters products. It is a panoramic receiver designed to show receiver response curves and wave forms of the transmitted signal. It is a safe assumption that the S-35 was built for intelligence and monitoring use and was not produced in great numbers.

You should note that the Hallicrafters introduced a less expensive 'first cousin' of the SX-28 known as the SX-32. The differences are these: the SX-32 has no audio Bass Boost control and no lock for the main dial knob skirt. The 32 also has only a switchable (on-off) ANL where the 28 has an ANL gain control pot and knob (upper right control). There are a few internal economies as well.

## THE SX-28 TODAY: USER NOTES

The only recent review of the SX-28 was that written by Bill Kleronomos, KD0HG, and published in his 'Vintage Product Review' column in the June 1990 issue of *Electric Radio*. [14] Bill did a beautiful 'bench test' review and I will rely on his findings for the numerical portion of these comments.

### Sensitivity:

The sensitivity on the higher bands where both RF Stages are engaged seems more than adequate. The less satisfactory sensitivity at Tropical Band and MW frequencies is really not that noticeable. However, I am currently restoring a RME DB 22-A preselector that should be a welcome addition to my equipment line-up for 'nostalgia DXing' on the Tropical Bands.

Bill used the 10dB S+N/N method. His figures for AM sensitivity were 2uV at MW and Tropical Bands frequencies and 1uV or less from 14 MHz up. This was measured with the slightly hotter 6AC7 in place of the stock 6AB7 as 1st RF amplifier. CW and SSB signals needed to be .25uV or better at 14 MHz to be readable.

### Selectivity:

The SX-28 offers six selectivity positions. The first three are for AM reception and are labeled Broad, Medium and Sharp IF. These selections engage various tuned L-C circuits. At the 6 dB down points, Bill measured "Broad" as 14 kHz wide and Sharp came in at 5 kHz. The three crystal filter positions were impressive, with the narrowest measuring 30 Hertz (Yes!) Using the Crystal Phasing Control and the Xtal Broad position (3 kHz), Bill notes that it is possible to "notch out" the 5 kHz beat note from an adjacent strong SWBC station.

My own experience tends to confirm Bill's findings empirically. However, from the point of view of an SWL, these findings are extremely misleading. It is possible to DX AM signals with the Xtal Broad filter invoked, normally riding on one side of the carrier or the other to receive an intelligible audio spectrum. THAT IS NOT THE PROBLEM! The problem is that the shape factor of the L-C circuit IF filters is such that the receiver is very annoying to use for program listening on the very crowded 6, 9 or 11 mHz International Broadcast Bands. The L-C filter skirts are so wide at 30 to 50 dB down that virtually every signal, no matter how strong, has a 5 kHz heterodyne in the audio background. This whine is generated if even moderate level signals present 5 kHz above or below where the receiver is tuned. This high pitched whine is even audible in the background of such local powerhouses as BBC on 5975 kHz in the evenings and 9580 kHz Radio Australia in the mornings. It is true that the 5000 Hz tone can be removed from the audio by an outboard audio filter. However, doing so also removes some of the high notes and general brightness from the otherwise marvelous audio of this receiver.

I might note that this 5000 Hz heterodyne note is the Achilles heel of most older major tube receivers - from a program listening point of view. This same problem exists with my totally remanufactured SP-600, and with my SX-42 and SX-62 as well. Only the HQ-180A, the 51J4, the R-390A and a few other major post-war tube receivers seem to have the broad filters with steep skirts necessary for high fidelity reception of modern International Band signals. This Achilles heel is what has made me most excited about applying KIWA Electronics new filter module to my older receivers. (Refer to the article by James Goodwin elsewhere in Proceedings 1992.)

### Audio Quality:

My intuitive feelings about audio quality are generally enthusiastic, Bill's bench findings show good frequency response and little distortion. He closed with the comment, "The SX-28 has darn good audio for a communications receiver." I am lucky enough to use a Hallicrafters PM-23 speaker enclosure with the original

10" speaker. On a 50,000 watt semi-local MW station, I can open the IF to 14 kHz, crank the AF gain about 1/3 of the way and enjoy wonderful audio. The only noticeably better AM audio that I have ever heard is from a few rare and expensive console radios from the late 1930's. Absolutely superb audio!

#### **Image Rejection:**

Bill's tests showed relatively poor image rejection with readings from 55 dB at 7 MHz to 30 dB at 30 MHz. These numbers are predictable for a single conversion receiver and are what popularized the tunable RF preselector/preamps for use with receivers of this general era. I have had no 'image problems' in my use of the SX-28.

#### **Stability:**

Bill ran a series of stability tests on his SX-28 at 7 MHz and 14 MHz. He found that the stability that he measured at 14 MHz was "unsurpassed by any tube type receiver that I've ever used except perhaps a Collins 32S3 (S-Line)." My experience is not quite so good, though my SX-28 is totally unrestored and still running with its original capacitors.

#### **Noise Blanker:**

Both Bill and I were surprised at the effectiveness of the noise blanker. The SX-28 was designed with the 'Lamb type' noise blanker rather than the much more common (and less expensive) noise limiters or ANL circuits. The gain of this blanker circuit is controllable from the front panel. Careful adjustment of the circuit can usually ELIMINATE power line hash, motor, dimmer and ignition noise.

#### **General Weaknesses:**

For some people, the lack of a digital frequency read-out is the major weakness of almost every tube receiver. For pedal-to-the-metal DXing, most of us would agree. You should also note the lack of single-side band capability and the lack of pass band tuning and a notch filter. If you want to be technically competitive with the NRD 535's of the world using a 50 year old receiver, attach a CCI digital readout and use a Hammarlund HC-10 (the IF and AF of an HQ-180A) accessory unit. That will nearly get you there... BUT WHY? As previously mentioned, though, the Achilles heel of this and similar receivers (from an SWL's point of view) is the damnably wide lower skirts of the L-C circuit-based IF filters. This is only a serious problem on the International Broadcast bands. However, it is a very serious weakness when trying to enjoy the otherwise awesome audio of this marvelous old war horse. Finally, the size and weight of the SX-28 have to be considered weaknesses. With the Art Deco case, this beauty tips the scale at nearly 80 lbs. and occupies more or less a 2 foot square on your radio table. Do you really want to lug one of these things around in your "declining years?"

### **MODIFYING THE SX-28:**

The only major article published detailing modifications to the SX-28 appeared in the May 1959 issue of CQ magazine. The author, B.A. Briskman, K2IEG, detailed installing a 'S-9er' (also covered in the May 59 CQ) to increase sensitivity as well as adding another IF section to improve selectivity. He also details adding a voltage regulator for the HF and BF oscillators and building a product detector for SSB operation.

The same May 1959 issue of CQ has a receiver mod question-and-answer column which covers further modifications to the SX-28. This group of mods (noise limiter, adding a crystal calibrator and attaching a pan adaptor unit) were developed at the Hallicrafters plant.

### **THE MODERN BOTTOM LINE:**

In good conscience, I can not recommend the SX-28 as a primary DX receiver. The HQ-180A, 51J-4 and R-390A are each superior DX machines and can be obtained for about the same general price. However, if your primary hobby is listening to the International Bands, or, if you can afford to own a 'listening radio' as well as a DXing radio, the SX-28 is just your cup of tea. If you would just enjoy owning the absolute classic tube-era shortwave receiver, buy one NOW! It is a thoroughly beautiful radio... beautiful to look at, beautiful to operate and, most of all, beautiful to listen to...

**Be the last kid on your block to ride the sky with the last of the Super Skyriders.**

## endnotes

- [1] Supposition by the author based on careful examination of all major preceding Hallicrafters (owned by Chuck Dachis) and examination of other contemporary receivers using Moore's book as a reference.
- [2] The development of the SX-28 is one of the more interesting stories to come out of the halcyon days of radio in the late 1930's. Bits and pieces of the story have appeared in print in recent years, often with regrettable errors or omissions. Through Chuck Dachis, The Hallicrafters Collector, I was extraordinarily fortunate to contact Mr. Robert Samuelson and Mr. Ferd Schor. They were, respectively, Chief Engineer and Lead Receiver Engineer at Hallicrafters in the late 1930's and throughout WWII. They were each kind enough to exchange several letters with me in early 1992 concerning the development and use of the SX-28.
- [3] Refer to *Communications Receivers, The Vacuum Tube Era: 1932-1981 2nd Edition* by Raymond S. Moore; pub. RSM Communications, 1991.
- [4] Refer to articles in *QST*: McLaughlin and Lamb, May 1936 and McLaughlin and Miles, March 1938. Both articles detail diversity reception.
- [5] Quoting introductory SX-23 advertisements in *QST* and other magazines.
- [6] Samuelson letter #1 to Bryant, 1992.
- [7] "Hams in the RID, the FCC's Radio Intelligence Division in Action" *QST* magazine, October 1944.
- [8] The AWA Review, Volume 5, 1990, contains the nearly official history of the FCC's R.I.D. in a wonderful article by the R.I.D, war-time head, George E. Sterling, W1AE
- [9] From Hallicrafters internal magazine "Tuner" in about April 1943, courtesy of Robert Samuelson.
- [10] Rough draft notes from Mr. Schor indicates that he had primary responsibility for design of the S-22 and S-27.
- [11] Samuelson letter #2 to Bryant, 1992.
- [12] From Hallicrafters internal magazine "Tuner" in November 1943, courtesy of Bob Samuelson.
- [13] Schor letter #1 in 1992.
- [14] *Electric Radio*, No. 14, June 1990, copies of this and all other issues maybe obtained from the publisher for \$3.00 each from *Electric Radio*, P.O. Box 57, Hesperus, CO, 81326. *Electric Radio* is a publication by and for radio enthusiasts interested in "hollow state" tube radio. Subscriptions are US \$20.00 (Second Class) or \$30.00 (First Class.)
- [15] Three relevant articles on SX-28 modifications, *CQ Magazine*, May 1959

FIGURE 14. Dr. Robert Samuelson, Summer 1992.

At the close of WWII, Bob Samuelson left Hallicrafters and entered the graduate program in Electrical Engineering at Northwestern University. After obtaining his doctorate at Northwestern, he began a long and productive career with Motorola Electronics in Phoenix, AZ. Dr. Samuelson retired as a senior executive in Motorola in 1980. Today he and his wife Marcy enjoy a very active retirement, splitting their time between the family home near Camelback mountain in Phoenix and their new condomenium in California.

Receiver Designer Ferd Schor remained with Hallicrafters for many years and designed over 50 of the company's receivers. He, too, has enjoyed a long and active retirement in California.

