

THE ITEM IN QUESTION

Spotlighting Noteworthy Artifacts From the Collection of The AWA Museum

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The Japanese STAR SR-550 Ham Band Receiver

Background of Star Co. Ltd. and the SR-550

The SR-550 Japanese communications receiver, built by the Star Co. Ltd. (formerly Fuji Manufacturing, Fuji Seisakusho), is just one of many High Frequency (HF) amateur radio receivers from the tube age that belong to the AWA Museum, but its provenance sets it above many others. This receiver can be considered among the first of many well-designed and constructed receivers from Japan.¹

Although the Star Co. Ltd. produced other receivers before the SR-550, this model set a high bar for the company's later SR-700 (with its matching ST-700 transmitter) and for other ham radio products that would later come from Yaesu, Trio (Kenwood) and Icom. Its production began in 1964. Some of the Star Company engineers would go on to become high powered innovators during their careers.

A Star receiver preceding the SR-550 was the SR-100 "Sky Friend", a clone of the Hallicrafters S-119 "Sky Buddy," produced in 1963 for SWLs. Star also counted among the many post-World War II Japanese companies that produced parts. Star's predecessor, Fuki Seisakusho, sold kits for AM and FM radio and later for TV.²

This predecessor company had existed at least since 1942 under its founder, Mr. Sato.³ In 1961, the company name changed to Star Co. Ltd. (its radios were already called "Star") and it positioned itself on the Second Section of the Tokyo

Stock Exchange. Sato retired in the same year, and by 1964 the stalled TV division was sold off. The ham radio market began to boom, but by 1969 the company's radio business was totally absorbed by Trio, Yaesu and others like Izumi Kogyo.⁴ According to Young Kim (K6HM), most of its engineers went over to these companies.⁵

In the technology transfer, as Kazuaki Kitahara (JA0EQL) reports, the lead engineer on the Star SR-550 project, Akira Tayama, left for Yaesu, drawing on his work at Star to help design rigs like the FRDX-400 and the FT-200, the latter known in the U.S. as the Tempo-One. Tayama is also known in Japan for his book on single sideband technology.⁶ According to Tetsuro Hanazawa (JA1VBN), Shiro Nomura (JA1CB) moved from Star to Trio and became involved in designing the TS-511S and much later the TS930S.⁷ Over at Trio (Later Trio-Kenwood) radios like the 9R-59D, DS and DE and then the TS-series were developed for the growing markets abroad. As early as 1963, Yaesu radios



Fig 1: Star SR-550 receiver front view.

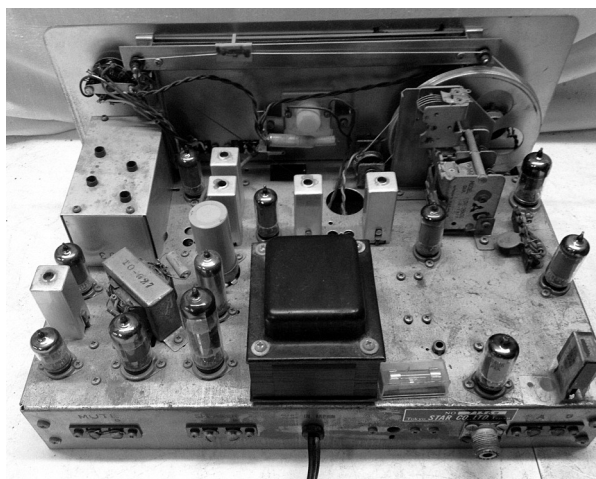


Fig 2: Star SR-550 receiver top view.

were sold under the Sommerkamp brand name in Europe. Star also sold, but briefly, to Europe and the Far East. Marketing and an equipment review of Star's 700-series appeared only once in the U.S., in the August 1967 issue of *QST* magazine. For a time, Bil Harrison (W2AVA) sold Star equipment at his three "Ham Headquarters, USA" stores in New York.⁸

Technical Description of the SR-550

The design of the STAR SR-550 Communications receiver is interesting. It covers only the Amateur Radio bands but includes 160 through six meters (pre-WARC band era). This superheterodyne circuit utilizes ten tubes and incorporates dual conversion for good image rejection and added selectivity. The design engineers selected modern seven and nine pin tubes: 6BA6, 6EA8, 12AU7, and the like, all of proven performance and in common use throughout the industry.

No surprises lurk under the covers. And yet the slide rule dial, in common usage at the time, complete with dial cord string wrapped around shafts and pulleys, which in turn rotate tuning capacitors and position dial pointers, functioned as smoothly as anything on the market. What separated this product from most was the linear spacing

on the dial that required just one set of markings, 20 kHz apart, no matter what band one chose. The dial frequency could be read further by means of a calibrated skirted tuning knob.

Adding six meters to a conventional HF receiver was a bit innovative and perhaps a stretch in design practice. Still, it was a good marketing move. At that time, six meters was similar to today's two meter FM for local chit chat. (Many will remember putting a six meter converter in front of an HF station receiver to get on VHF.)

A tough competitor for the SR-550 at a similar price and with the same features was the Hammarlund HQ-110, for just thirty dollars more. What Hammarlund had was a very familiar brand name, something hard to beat in the marketplace.

Beginning at the RF section along the signal path, a 6BA6 was used to take advantage of this tube's high gain, reasonable signal-noise ratio at HF, and remote cut-off characteristics that make this tube perform well under AVC. The receiver's RF GAIN control is a 10k pot to ground from the cathode. Unlike many designs of the era, the RF amplifier stage was not gang tuned with the main TUNING knob. Instead, the engineers had a separate variable capacitor, with its own shaft and knob to resonate the stage at the incoming frequency. That control was labeled RF TUNING and today would be called a preselector. This certainly saved a lot of design work and hardware to make the RF stage track with the frequency-setting oscillator. One star for the STAR SR-550.

The first local oscillator is one-half of a 12AU7, with the second triode a cathode follower to drive the mixer. Special design effort went into making the frequency linear with the turning of the variable capacitor. Without that effort, the linear dial calibration would not be possible. Curiously,

the second harmonic of the oscillator is used for receiving above 21 MHz. There must have been some midnight oil burned to make that oscillator work at both HF and VHF and maintain linearity. Unrecorded trickery like this will always be lost to time. The engineers deserve credit; it worked!

The first mixer, a 6AU6, is cleverly set up to use the ham radio convention of operating lower sideband (LSB) on 160, 80 and 40 meters and upper sideband (USB) on the higher amateur bands. The frequency scheme is such that the oscillator's high or low side injection results in a mixer conversion that is always correct and no front panel LSB/USB switch is needed. The first IF is at 1650 kHz. The second mixer, a 6BE6, has its own fixed LC oscillator running at 1705 kHz, which when mixed with the 1650 kHz first IF, produces the second IF frequency of 55 kHz. It is at 55 kHz that the receiver's selectivity takes place in the form of a four-position SELECTIVITY switch, selecting bandwidths of .5, 1.2, 2.5 and 4 kHz. The switch changes coupling capacitors in a four-stage bandpass filter arrangement to shape the filter.

A beat frequency oscillator control, labeled BFO on the front panel, allows shifting of the signal within the passband and is calibrated to facilitate tuning of SSB signals. This BFO control looks, feels and works the same as the PASSBAND control

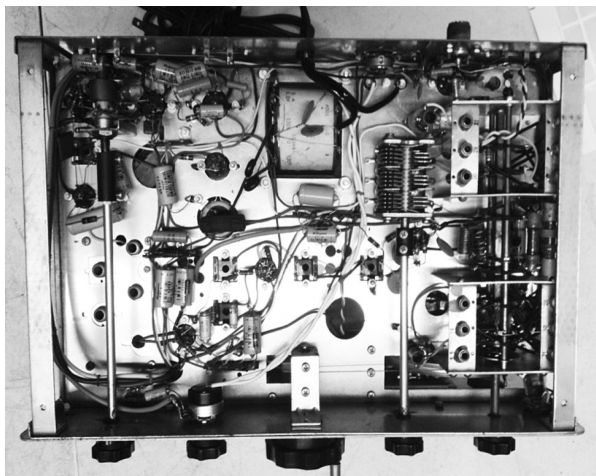


Fig 3: Star SR-550 receiver underchassis view.

seen on early Drake receivers such as the 2A, 2B and later. The 55 kHz tunable bandpass filter with all of its individual inductors and capacitors must have been a difficult circuit to tune in production. The designers put all of that circuitry into a separate shielded module called the Variable Selectivity Bandpass Filter. It's a sure bet that this module was tweaked and tuned by a skilled technician prior to being installed onto the main chassis.

Two 6BA6 2nd IF amplifier tubes give plenty of gain while the pentode section of a 6EA8 forms the beat frequency oscillator. The receiver's S-meter works off the cathode current of the first 6BA6 IF amplifier. The nicely processed IF signal now gets switched either to the triode section of the 6EA8 as a product detector for SSB/CW, or to a simple 6AL5 diode detector for AM,

CORRECTION

Correction of Paragraph 2 in the last issue (*AWA Journal*, Vol. 58 / #1, p. 13),

“The Cold War Dual-Alphabet T 63 Teleprinter” (Brown & Hopkins):

The company C. Lorenz AG in Templehof-Berlin was a producer of railroad signaling equipment and early wireless sets. In 1929, they built their first Start-Stop teleprinter, with a license from the Morkrum-Kleinschmidt Company (later, the Teletype Corporation.) to reproduce its Models 14 and 15.

via the front panel FUNCTION switch.

The other 6AL5 diode performs AVC detection and automatic noise limiting (ANL), both of which can be turned ON or OFF by front panel slide switches. The detected signal now goes on to the audio chain where there is a slight departure from the norm of the day. Where U.S. and European designs seemed unable to get away from 12AX7s and 6AQ5s, the Star Company decided to use a single triode/pentode: the 6BM8.

The output transformer fed 4- or 8-ohm speakers via a rear mounted terminal block. A speaker-disabling headphone jack affixed to the front panel is fixed at 4 ohms. The power supply is a conventional solid-state full wave rectifier feeding two 60 microfarad filter capacitors, and a VR-105 gas regulator tube supplies B+ to the oscillators. It is curious that the power transformer primary in this set is only tapped for either 100 or 115 VAC. The puzzle is: why wouldn't Star supply a universal power transformer equally suitable for 220 VAC to bypass the need for separate supplies? Europe and other regions where this radio was also sold use 220 VAC for common household use.

The last tube in the set is a 6AU6 connected as a conventional crystal oscillator, rich in harmonics, and used as the receiver calibrator. Unique here was the selection of a 3.500 mHz crystal for the calibration signal. In operation one might set the receiver for 40 meters, tune the dial for 7.00 and expect to hear the calibrator's second harmonic. If the dial pointer was not exactly at

7.00 when the calibrator was heard, one would then set the pointer correctly and rotate the front panel RESET control to move the calibrate signal precisely on 7.00 MHz. The RESET control rotates a small variable capacitor in parallel with the main tuning capacitor to pull the bottom of the band on frequency. After that, one simply relies on the carefully implemented linearity of the oscillator to remain on frequency throughout the rest of the band. This scheme worked well, except for six meters: the 15th harmonic of 3.5 MHz. It had to be calibrated to 52.5 MHz.

There is no evidence that Star ever made a matching transmitter, but provision is made for receiver muting. The bottom line is that this receiver represented a solid design approach, considering the cost restraints of where it fit in the market place. Bill Harrison's listed price in New York of \$150 for the SR-550 was a bargain price for a ten-tube receiver of good, albeit not state-of-the-art design.

The AWA Museum's set is the only one that has turned up locally in fifty years. Moreover, the industry standard reference books on communication receivers by Fred Osterman and Raymond Moore don't even list the Star brand, let alone this model.⁹ Indications are that the 550 sold better in Europe, which is probably a matter of marketing activity rather than any acceptance decision by the ham community. Star was simply outpaced by Yaesu, Trio and the competing American brands.

REFERENCES

1. The nature of Japanese creativity and innovation in electronics (primarily solid state technology) is amply discussed by writers such as: Makoto Kikuchi (1983); Gene Gregory (1986); Seiichi Nakajima (1988); John Sprague (1993); Bob Johnstone (1998); Anton Huurdeman (1993).
2. Koji Hayashi, at www.geocities.jp/radioman/HomePageRadio/Radio_Company.html. Hayashi's callsign seems to be JE1CAQ. Hayashi introduces several companies from the early days: "I have tried to write a 'History of Radio Manufacturers' by connecting sporadic literature and Internet information. There are also many errors. We are waiting for your comments." (All websites referenced herein retrieved as of Nov. 2017.)
3. Tetsuro Hanazawa (JA1VBN) at: <http://ja1vbn.la.coocan.jp/radio/star/index.html>.

Hanazawa's web page provides the best list of radio equipment built by Fuji, later, Star Ltd.

4. Ibid. Hanazawa cites some sources for his info on Star Co. Ltd.: "Thanks Mr. Yamamoto, JA9TTT/1, Mr. Kato, Mr. Tsuda, JA4JNR/9, Mr. Kurisu, JF1CMK and Mr. Kobayashi for helpful information about Star's unit and the Star company."
5. Young Kim (K6HM) at: <https://groups.google.com/forum/#!msg/rec.radio.amateur.boatanchors/5tcm91NskAs/K3UQnYKDYi0J>.
6. Email from Kazuaki Kitahara (JA0EQL) to Hopkins, Nov. 14, 2017: Akira Tayama, SSB, Japan Broadcast Association, 1972.
7. <http://www.eham.net/articles/3167>; from 1989 to 1997 Nomura was director of Kenwood USA operations.
8. *QST*, August, 1967, p. 160; Review article of the STAR receiver SR-700E and transmitter ST-700E by Doug DeMaw (W1CER) on pp. 48-52.
9. Fred Osterman, *Shortwave Receivers Past and Present*, 2nd ed., Reynoldsburg, Ohio: Universal Radio Research, 1997; Raymond S. Moore, *Communications Receivers, the Vacuum Tube Era, 1932-1981*, 1st ed., RSM Communications, 1981.



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