THE HAMMARLUND SP-600

Phil Bytheway

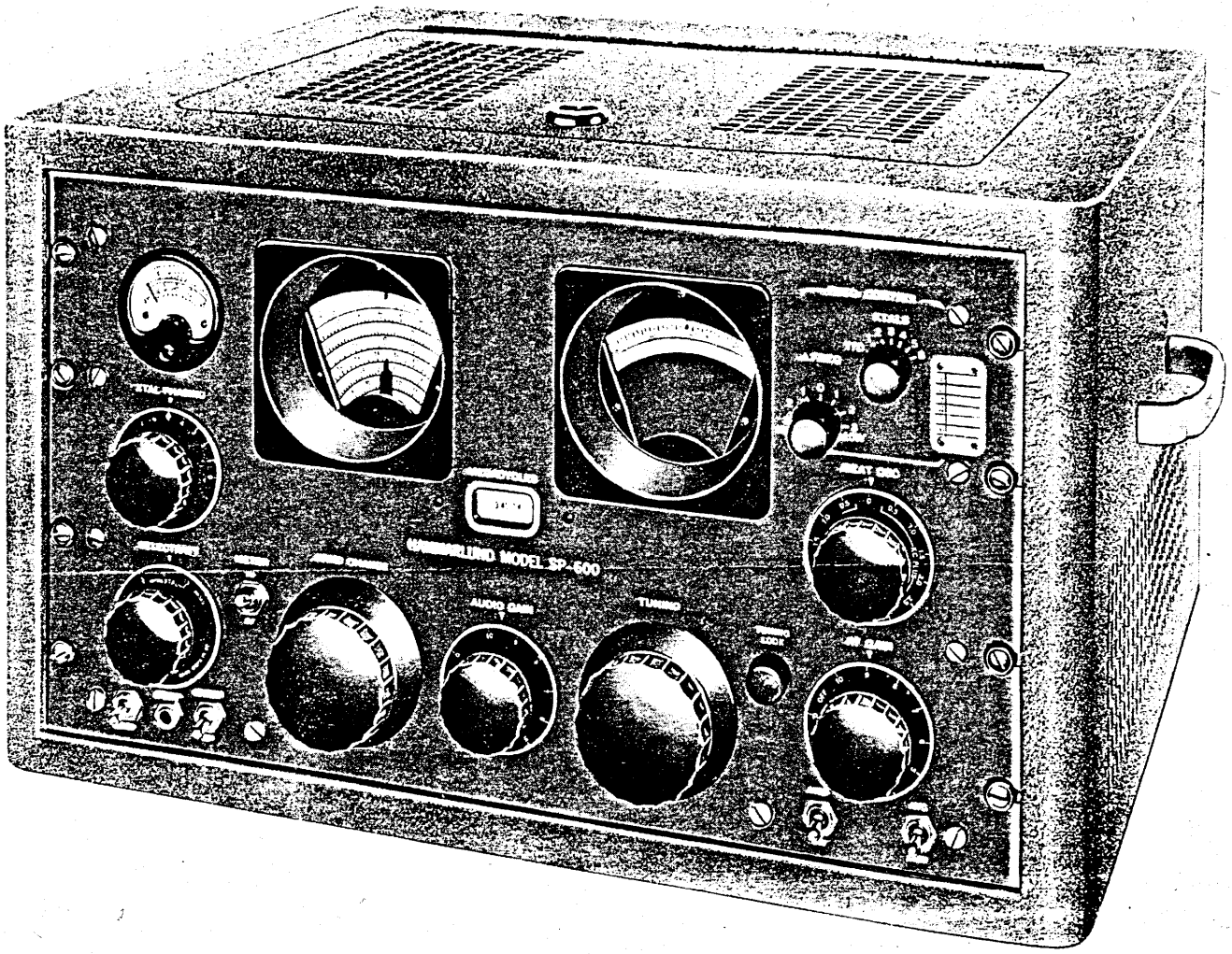

Figure 1: The Hammarlund SP-600-JX

Look at that monster; it must weigh a ton! No, actually the SP-600-JX-xx weighs between 75 and 95 pounds depending on whether or not it comes in a cabinet.

The SP-600 (Figure 1) comes from a long line of snazzy Hammarlund 'Super Pro' receivers, the most notable being the subject of this review. Some models come with a 'J' added to designate a 'militarized' version which used "components having characteristics which are the equivalent of military component specification insofar as practicable"[1]. The 'X' versions can receive 6 fixed channel crystal frequencies in the 0.75 - 54 MHz range. The xx number after the final hyphen indicates the model number within the series which ends with the -26 model. Its design dates from 1950 and variants were built up to the early 1960s. It was advertised for sale in QST as late as 1969. Most were originally sold to the military, government agencies and research laboratories for $1000, but they are now available for a between $50-200 depending on condition.

The SP-600 sports a 20 tube complement, self contained power supply (no solid state!) and can easily be mounted in a 19 inch rack. It is 10 1/2 inches high and 16 1/2 inches deep. The SP-600 was designed for the reception of AM, CW, RTTY and can be used in diversity applications. Coverage is continuous and ranges from 540 kHz up to 54 MHz (6

meters) in 6 bands. The band breaks are at the following frequencies: 1.35, 3.45, 7.40, 14.8 and 29.7 MHz. There is some overlap between the bands. The power supply is designed to operate from AC between 50 and 60 Hz and line voltages between 95 and 270 volts (8 tap settings on main transformer). The marsh mellow toasting factor or typical power draw is 130 watts (1.25 A at 117 volts maximum).

First class construction techniques were used throughout the SP-600-J series. The main tuning capacitor is gold plated and the RF coils for the different bands are contained within a silver turret assembly which rotates the proper coils into position. The VFO drive train is a well made brass gear assembly and the chassis is made from anodized aluminum. To top it off, some sets have all solder connections coated with conformal coating for corrosion protection.

Over the course of my research, I sent questionnaires to 15 SP-600 users, an will quote their responses throughout this review.

FRONT PANEL

Figure 2 shows the front panel of a SP-600-JX-17. Noted SW DXer John Bryant feels that the general appearance of the SP-600...

> *"is one of the most beautiful major receivers made (SX-28 being first, then the SX-88, maybe tied with the SP-600). Unlike the R-390A, the SP-600 is just a pleasure to sit in front of. I also think all of the large knobs are just exactly the right size for hours of use (others have made this exact same comment). Using this receiver shows me, clearly, what we gave up to the miniaturization thrust of 'modern' receivers. Finally, the size and feel of ALL of the controls lets you know that you are dealing with a SERIOUS radio."*

Other survey responses are in agreement with John and no one indicated a desire to relocate any of the knobs.

A tour of the front panel follows. Numbers correspond to those used in Figure 2.

1) The "PHONES" jack delivers 15 mw to an 8000 ohm load if the 600 ohm output (on the back panel) is driving 500 mw to 600 Ω. Audio is very weak with 8 ohm headphones as expected. However it does work well into "auto-level" and "adjustable level" tape recorders. The user can also use the 600 ohm outputs on the rear chassis for audio.

2) This switch is used to select the fixed crystal controlled frequencies and must be set in 'VAR' for normal tuning operation.

3) Selects between internal and external 2nd mixer frequencies (some models). I have not seen this on any of the sets I've viewed and no one mentioned having a set with this switch, so the manual I have is somewhat unique.

4) BFO internal/external, AVC fast/slow control (some models). Once again, I have not seen this on any set but certainly some sort of AVC control is preferred. John Leary mentioned that he built a separate AVC circuit for his set. In the course of normal DXing, situations will arise in which the user needs more than on/off AVC control. On BCB, the 'flutter' associated with so called 'graveyard' (local) channels demands a much slower AVC than on the regional or clear channels.

5) Turns the BFO on/off. Definitely a preferred feature. So often the 'modern' radio designers have decided when to enable the BFO, often excluding certain bandwidth selections unless in SSB. You can use the SP-600s BFO with all selectivity selections.

6) Puts the set in standby, thus disabling the RF amplifiers via screen voltage. B+ is applied at all times.

7) RF gain also contains the AC on/off switch.

8) Tuning knob. This is connected to a flywheel counter balance which allows for very easy tuning (and high speed spinning!). John Bryant notes: "the aesthetic thrill of giving the tuning knob a spin is WONDERFUL! The gear train and the big flywheel seem perfectly matched to move quickly and accurately across the bands. Clearly, the best main tuning knob in the business." Anti-backlash gear tensioners are used in all interfaces and there is no discernible backlash when tuning. The ratio for tuning to main dial is 50:1.

9) This large knob is used to change bands. Like all boat anchors, it is difficult to turn and a good grip with high torque is required. Keep in mind that 4 sets of coils are being manipulated when changing bands (a la HRO!).

Note: the tuning/band knob arrangement of the Super Pro series differs from the 'traditional' Hammarlund/Collins arrangement of leftmost knob for tuning, rightmost knob for band changing/band spread. For someone moving between an HQ-180/R-390A and the SP-600, a bit of reorientation is necessary. Do NOT try standing on your head. Those of us who are left handed (a minority to which I belong) are further hampered by having to cross the front of the receiver to tune the set. I still love the ease of tuning however; it really flies!

10) This allows +/- 3 kHz variation of the tuning frequency when in the fixed crystal mode... nice to have front panel fine tuning when using a crystal.

11) Readout in 10 kHz to 1.35 MHz, 20 kHz to 3.45, 50 kHz to 7.40, 100 kHz to 29.7 and 200 kHz to 54 MHz. In addition, at the top, a 0 to 5 log scale is provided for use with the vernier dial (explained later).

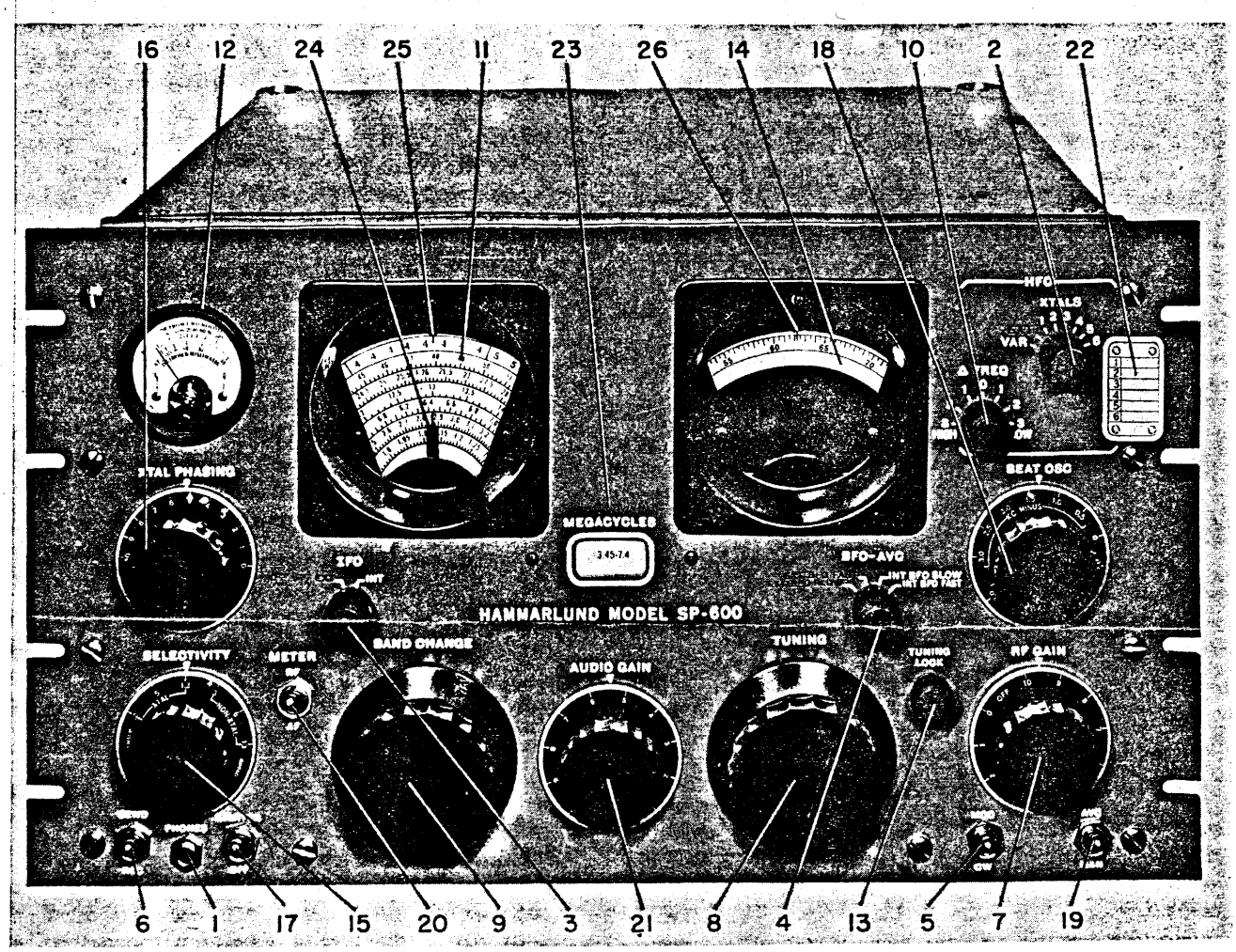

Figure 2: SP-600-JX-17 Front Panel

12) S-meter, 0-200 μA, calibrated directly in kHz with respect to 455 kHz. This one also shows AF strength, although most folks don't use this feature. More users rated the S-meter performance as 'ok', a couple indicated 'accurate' and only one called it 'poor'. There are adjustments on the rear chassis for this so perhaps a wide range of opinions are possible. On my set, I noted that there was less than full deflection when tuning in locals and slight deflection when tuning in weak signals, much more dynamic than a lot of signal strength meters I've used. I prefer a meter that doesn't pin easily, which allows me a visual means of 'peaking/tweaking' antennas and tuners. If the S-meter pins easily, one can still use the slightly detuned BFO audio technique for peaking external devices.

13) Locks the internal tuning mechanism, although the tuning knob still rotates.

14) The Vernier dial is a full 0-100 with markings every 0.5. This dial, combined with the log scale at the top of (11) can be used to return to a known frequency within 1 kHz, you just have to write the log value down!

15) Bandwidth, 13.0, 8.0 and 3.0 kHz bandwidths are available without the crystal filter. The crystal filter is switched in for bandwidths of 1.3, 0.5 and 0.2 kHz. Most folks use either the 1.3 or 3.0 kHz position for DXing and the 3.0 or 8.0 position for casual listening. Close DX situations almost always require the 1.3 kHz filter.

16) This control is used when in the 1.3, 0.5 or 0.2 positions to adjust the phasing of the single pole crystal filter. The single notch can be moved through the passband. I can't find any documentation on the notch depth. The manual describes it as 'extreme selectivity for the high attenuation of closely adjacent interfering signals.'[1] Most users rate the usefulness of this feature as "excellent" to "good".

17) The noise limiter tends to mess up the audio, because it is designed for to reduce noise from ignition systems and other pulse noise sources.

18) The BFO frequency control is very handy. It is calibrated to +/- 3 kHz in 0.5 kHz increments that are at least 1/4 inch apart. When combined with 'normal' band station separation (10 kHz BCB, 5 kHz SW), it can be used to determine the frequency of off channel stations within 0.1 kHz. Of course a frequency counter/readout would be a better solution, but for a strictly analog readout, this setup is most impressive.

19) Enables/disables the AVC. It's a shame this set doesn't have an adjustable AVC timing. It would help out quite a bit in some BCB flutter frequency situations.

20) This allows the user to switch between RF and AF readings on the 'S-meter'. AF is generally only used for adjusting low-level audio into a telephone cable. These receivers were often installed in remote receiver sites. Audio outputs went to a control station through telephone circuits in which levels needed to be closely controlled. For use with a speaker at the same site as the receiver, the AF meter option really isn't needed.

21) Controls the volume into the headphones and rear 600 ohm outputs.

22) A good idea to keep track of the crystal values plugged into the crystal rack, just in case you forget such things.

23) It's also a good idea to know what band the set is tuned to, even though the pointer (24) moves up (and down) as the band is changed.

25) Combined with the pointer in the Vernier window (26), station 'log' values are tabulated.

So much for the front of the set. The antenna connection is located 'inside' the set mounted on top of the RF chassis (mine is BNC). On the back there is a power connection, a couple of fuses and a spare fuse box (usually missing!). You will also find an array of screws for the diode output, AVC and audio output connections. A four line 'remote' female connector allows access to various internal signals. A PL-259 connector is available for the IF output (not specified, but measured 3.5 V peak-to-peak). Rear mounted screw adjustable potentiometers allow for BFO and 'S-meter' adjustments for both the RF and AF modes. On the -17 versions, two additional PL-259 connections provide inputs for externally supplied 2nd VFO and BFO signals.

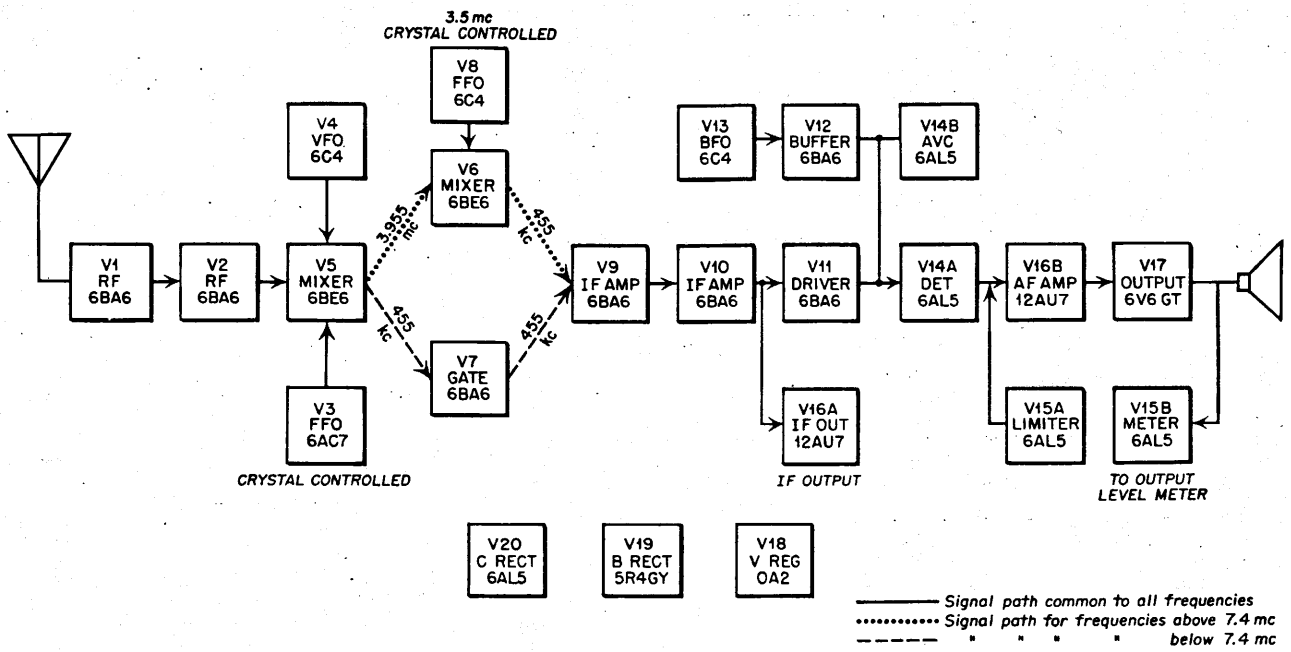

Figure 3: SP-600-JX-17 Block Diagram

CIRCUIT DESCRIPTION

Figure 3 shows a simple block diagram. Four band dependent tuned circuits are switched in for the 95 ohm balanced antenna input (before first RF), first and second RF (both 6BA6) and first VFO (HFO-6AC7) circuits. In the fixed crystal controlled mode, the crystal controlled oscillator is connected in place of the first VFO (thus implying that the fixed crystal frequency is not the same as the desired frequency). Depending on band selection, the first mixer (6BE6) produces a 455 kHz signal for bands 1-3 - below 7.4 MHz, or 3955 kHz signal for bands 4-6 - above 7.4 MHz. The second VFO (6C4) generates a crystal controlled 3.5 MHz signal for the 2nd mixer (6BE6). On some sets, this second VFO is selectable from the front panel to an input on the rear chassis. This all means the set is single conversion below 7.4 MHz and double conversion above, with 455 kHz as the final IF frequency.

The 455 kHz signal via the gate (6BA6 - below band 4) or 455 kHz output of the 2nd mixer (band 4 and above) is selected for injection into 2 IF stages (both 6BA6). The selectivity switch adjusts all 3 IF coils (before 1st IF, between 1st and 2nd IF and following 2nd IF) with the first (before the 1st IF) being the location of the crystal filter and phase adjustment. The output of the 2nd IF is buffered (12AU7) to a connector on the rear chassis. This output can be used with a matching panadaptor for viewing post filtered IF behavior. The RF gain potentiometer controls grid voltages of the 2 RF and to a lesser extent the 2 IF tubes. Following the driver (6BA6), the audio is extracted with a diode detector (6AL5). The BFO circuit (6V4 LC controlled oscillator followed by 6BA6 buffer) is coupled at the driver. Once again, in some receivers, the BFO is selectable to a rear chassis connector via a front panel switch (which also adjusts AVC attack speed). The AVC is buffered (6AL5) and drives the gain of the 2nd mixer/gate and both IF amplifiers, as well as the S-meter (when in the RF mode).

The output of the detector is clipped by the noise limiter (6AL5 - when enabled) and fed into the Audio gain controlled AF amp (12AU7) and presented to the single, class A output driver (6V6) which drives the 600 ohm (at 2 watts) and headphone outputs and the S-meter (when in the AF mode). The B+ is regulated to 150 volts (OA2).

THE THREE S'S AND MORE

SENSITIVITY. The SP-600 manual rates sensitivity at 2.3 uV or better over the entire tuning range for a signal to noise ratio of 10 db at 20 mW output with RF at maximum (1 μV for CW). For John Bryant,

> *"The intelligibility of weak signals is EXCELLENT. It was far better than my NRD-525 in many careful comparisons. When using the 525 and MAP combination to compare to the SP-600, the SP-600 was almost always better or tied with 'the best solid state can do'. The SP-600 is very sensitive and then the tube audio quality really improves intelligibility."*

Bill Kleronomos says

> *"Comparing it head to head with the R-390A, HQ-180, SPR-4 and R-70, using similar antenna, I did not find any situations in which the SP-600 was unable to receive a signal the others had. Sensitivity was measured using a 30% modulated carrier to check the 10db S+N/N rating of this receiver. For those of you not familiar with this test, it takes into account the thermal and other noise produced within the receiver and provides a figure of merit used by the electronics industry. Merely hearing a signal is not good enough if it is masked by a high internal noise level! The sensitivity was checked at 1, 4, 14 and 50 MHz and measured 0.6, 0.6, 0.7 and 1.5 μV, respectively. This is not bad for AM sensitivity. CW signals were readable at 0.1 uV or less throughout the range. Overall, this receiver has very good sensitivity with somewhat high thermal background noise."*[2]

SELECTIVITY. (Figure 4) Selectivity is variable: 13, 8 and 3 kHz bandwidths are available without the crystal filter. With the crystal filter, bandwidths are 1.3, 0.5 and 0.2 kHz. The filter's phasing knob allows for the frequency adjustment of the single notch. When properly adjusted, the single pole crystal filter provides very, very good single signal CW reception using the narrow bandwidths.

For domestic BCB DX, the SP-600 performs well. I typically use the 3 kHz position, as the 1.3 kHz was too narrow for my tastes. Foreign splits are readable in the 3 kHz bandwidth. What with domestic broadcasters squeezing every kHz out of their bandwidth, a loop antenna is almost mandatory for adjacent channel reception, even with the best of selectivity enhancements. I sometimes used the 1.3 kHz position to DX. However, in my SP-600, there appears to be quite a bit of loss associated with the crystal filter... perhaps mine is not perfectly aligned.

John Bryant adds

> *"For use on shortwave, either listening on the International Bands or DXing on the Tropical Bands, the selectivity of the SP-600 - stock - is not up to modern standards and almost makes this otherwise wonderful receiver unusable. The L-C IF filters are not well suited for AM reception on the modern densely packed International Bands. The 13 kHz filter was always too wide for anything except local powerhouse MW reception. The 8 kHz filter can be used to a degree on the International Bands, but the shape factor is so bad that all sorts of 'trash' comes in under the skirts of the filter. There is also a continual 5 kHz whine from adjacent channel signals even when tuned to the strongest International signals. The 3 kHz filter also has such wide skirts that the continual weak 5 kHz hetrodyne is present. The 6 dB width of this filter is, however, too narrow for really good audio when SWLing. For casual listening, a low pass audio filter would clear up the hetrodyne, but rob you of the higher audio frequencies. The 3 kHz filter is marginally useful as a DX setting, however, the terribly wide filter skirts still let in a lot of trash. The 1.3 kHz crystal filter is a good DX setting for the Tropical Bands, but very careful tuning is required. I have no experience DXing with the narrower crystal settings.*

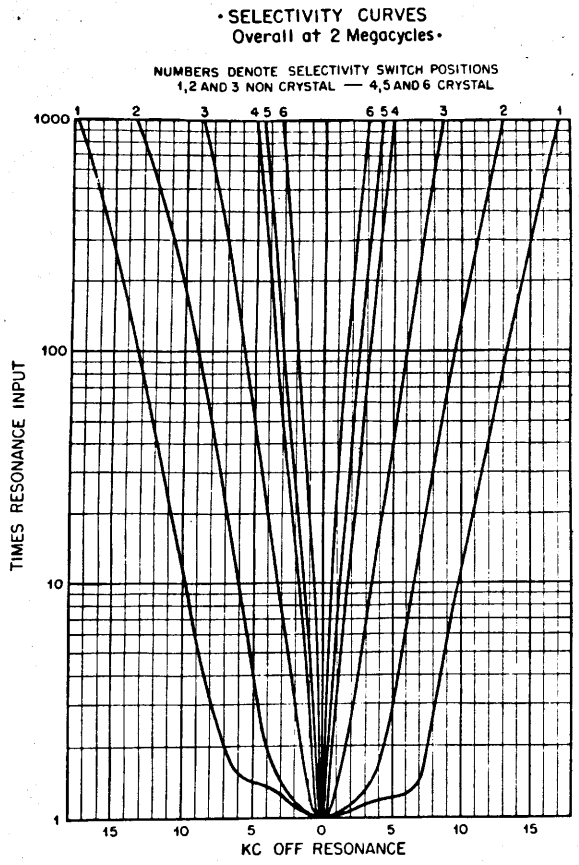

Figure 4: SP-600 Selectivity Option Curves

"My experience leads me to strongly recommend some modification of the IF situation if this otherwise wonderful receiver is to reach its full potential as both a DX and listening receiver on shortwave.

"One approach to this problem is adding one or two more modern IF filters to the set... possibly the new add-on filters from KIWA Electronics which are reviewed in Proceedings 1992. I have not done this, but James Godwin has. Refer to his article in Proceedings 1992.

"Currently, I am using a Hammarlund HC-10 unit in conjunction with the SP-600 (a 2700 ohm or so dropping resistor is best for this interface). This unit receives a 455 kHz signal from the output port on the rear panel of the SP-600 and then processes it through what is, essentially, the IF and AF sections of an HQ-180A. It provides a tunable IF notch filter, passband tuning, selectable sideband AM and SSB reception and sports excellent IF filters (at 60 kHz). The HC-10 and SP-600 combination provides excellent selectivity and a nice wide (6 kHz) setting with steep filter skirts, perfect for shortwave listening."

STABILITY. Per the manual, frequency drift after a 15 minute warm up period ranges from 0.001-0.01%. I can't really argue as I've never noticed any stability problems. Bill Kleronomos notes

"A series of stability tests were conducted after a 1 hour warm-up. Due to the thermal inertia exhibited by the massive silver-plated cast front end assembly, I observed that stability continued to improve until thermal equilibrium was reached. This took about six hours! For the most critical applications, I recommend leaving this receiver on all the time in standby mode. I also noted that stability was greatly improved by using the 130 volt tap in my area (versus the 117 volt tap typically used) where the nominal line voltage is 123 volts. After warm up, I measured the stability over a 10 minute period. This receiver held to within 30 Hz at 14 MHz and 10 Hz at 7 MHz. The BFO drifted less than 1 Hz over the same period. In crystal control at 10 MHz, drift was less than 2 Hz over 12 hours. Mechanical stability was checked at 14 MHz. Shaking the operating desk produced no change. Frequency only jumped a few Hz when a sharp blow was applied to the cabinet."[2]

IMAGES: There is a weak birdie on 910 kHz, and the normal expected mixing spurs from locals are evident across the BCB. Using a loop antenna only alleviates the problem if you null the offending dominant station. The preselection provided by the loop's tuning doesn't seem to help. The two RF stages are perhaps more a problem than a blessing in the SP-600 (many signals get into the first mixer). Image and Spurious responses are rated at better than 74 db. Bill Kleronomos again "These were checked at 40MHz and were unmeasurable due to test equipment limitations, which means 90 db or better; an outstanding figure."[2]

AUDIO DISTORTION: Measured distortion at 1kHz ranged from 3% at 100mw, 6% at 500 mw and 10% at 1 w. Audio response was basically flat from 100 Hz up to the selectivity limit.[2] The only audio distortion I noted was when the Noise Limiter was switched on. Although the limiter works very well on noise, it also distorts the audio, often making signals difficult to understand.

PRACTICAL USE AND STUFF

ANTENNAS: John Bryant has used 90 meter full wave deltas, an array of 450' Beverages and an amplified ferrite bar loop (for MW). All are impedance matched to 50 ohms. All seem to work well with the SP-600's antenna input (95 ohm) on Tropical Bands. John does not own an antenna tuner, however, with impedances already closely matched, he

feels that a tuner would not improve matching. On the other hand, my experiences with various MW loops (4-5) has been somewhat different. I was unable to get my 'Wedge' loop to perform well with the SP-600. The Wedge has a single ended FET input amplifier with a 50 ohm emitter-follower output stage. The Space Magnet loop (with a similar, but different emitter-follower output stage) was the best of the bunch, as it appeared to have little or no loss. There is no antenna trimmer on the SP-600. Those surveyed indicated a preference for one and most users indicated that they used an external tuner. It is a clear necessity if interfacing with a wide variety of antennas.

TUNING: I've found tuning on the BCB to be very nice with this set. Naturally, the BCB has the largest distance between stations... I can imagine the serious SW DXer having problems in crowded bands where the space between 5 kHz stations is a breath away. Using the variable BFO, it is fairly easy to nail BCB stations within a kHz; even eyeballing to 0.1 kHz when appropriate, although I really don't have much experience using the SP-660 to hear 'off frequency' foreign stations. Since the BCB is broken into two pieces (breaks at 1350 kHz), the flywheel action is a MUST for bandscanning. The entire BCB readout is to 10kHz, including the portion on band 2 from 1350 to 1600. Above 1600, marking moves up to every 20 kHz as noted above.

John Bryant adds

"From an aesthetic point of view, I love the SP-600 tuning. However, from a practical point of view, it leaves much to be desired. The commitment to a single tuning rate, rather than main and band spread, forced the designers to compromise on gear ratios; this is one receiver that really needs a stick-shift transmission. The counterweighted flywheels do make moving from one part of the dial to a distant point a fairly easy and rapid task. However, for fine tuning or slowly sweeping across one of the Tropical Bands, the gear ratio is wrong... you truly need the touch of a safe cracker. I find that I always need to throw on the BFO to make sure that I am exactly tuned to the signal. I do wish that there were either gear-driven or electrical incremental tuning. On the other hand, tuning the SP-600 is FUN... you are aware of controlling a real radio and you are aware that it takes practice and skill to get the most out of this beauty. It is sort of the feeling that F-16 pilots must have... it ain't easy, but is sure the heck is fun.

"I have only used the logging scale a few times just to see if it would work. It works like a charm. The receiver is stable enough that I can return to the same signal days later very easily and very predictably. If I was not lazy, I would have developed the frequency charts necessary to be able to read frequencies to the kilohertz. Instead, I have installed the digital frequency readout by CCI which is reviewed in Proceedings 1992. I feel very guilty about this, I should be a purist and use charts. I have both a 200 Hz and a 1 MHz crystal calibrator on board my SP-600. Using those to judge how much the dial is 'off' in a particular area, I can read the main dial to +/ - 5 kHz. Not bad. It is also rather easy to see that the dial itself is not quite linear with the radio. It is quite close, however."

SPEAKER: I never got a speaker for the set because it has a 600 ohm output. The scarcity of 600 ohm speakers is one of the drawbacks to buying any surplus receiver. I have used the SP-600 as a Trans-Pacific parallel checking set; it gets the stronger NHK stations easily enough when using a 150' longwire. I switch it into my 'audio system' consisting of a multiple selection switch feeding the input of a reel-to-reel tape recorder always kept in the 'record' mode. Volume adjustments are easily made with the audio gain knob on the SP-600 or the record level knob on the tape recorder.

COMPARISONS

David Clark rates the SP-600 better than an HQ-180 on BCB, but gives the edge to the HQ-180 on Tropical Bands, and generally prefers the SP-600 over an R-390A. Jef Jaisun notes that it outperforms a GE Superadio II and Sony ICF-SW7600 on MW. Bill Kleronomos prefers his SP-600 for casual listening and fast tuning, something impossible to do with his R-390A. Hank Holbrook prefers the HQ-129X which is far superior for crystal tuning. Shawn Merrigan prefers the tuning of the SP-600 when bandscanning and against the R-390A and NRD-525 it compared favorably, though harder to find a specific station.

MODIFICATIONS - ELECTRICAL PROBLEMS

BLACK TUBULAR CAPACITOR: This is documented over and over; they simply must all be replaced. These black tubular capacitors (39 - 0.01μF, 14 - 0.02 μF) are famous for developing leaks and shorts thus clobbering the performance of this set. And a potential fire hazard as well! They should be replaced with 1 kV disc ceramics. Unfortunately, a number of space problems will arise when doing so, as the circuitry is often crammed. People used to doing this kind of work usually spend about 100 hours at it! It is an exercise in dexterity and perseverance and should not be attempted by any but the most experienced people. An excellent technique is to make small drawings of the circuitry BEFORE removing the tubulars, then, with the help of the schematic few errors are made. It's also a good idea to test

your replacement capacitors BEFORE installing them. Interesting descriptions of the task can be found in *Hollow State Newsletter* #19, p 7-8, #20, p 2.[3] Thanks to Bob Kulow for pointing this out to SP-600 owners... and yes, all users surveyed had either replaced their capacitors or had problems with 'blown' ones (and have their fingers crossed!).

FILTER CHOKE LEAKAGE: Remove all wires from both filter power supply filter chokes and measure the resistance to ground. Many are less than 15 ohms indicating poor internal isolation from ground. It's best to insulate the chokes from ground by enlarging the base plate mounting holes, and then remount the chokes using insulated step washers. Don't forget to remeasure the resistance after mounting to be sure they are completely isolated. Hollow State Newsletter #18, p 4.[3]

SELECTIVITY ENHANCEMENT: Dallas Lankford describes a technique for adding Collins mechanical filters within the filter preceding the first IF in the Hollow State Newsletter #15, p 4-7.[3]

Three excellent and interesting articles by Bill Kleronomos in Electric Radio #20, 21 and 22 describe several additional receiver 'tweaks' and modifications. These include: frequency drift due to poor B+ and filament voltage regulation (vastly improved SSB and CW reception), construction of a high performance product detector (everyone needs a product detector... although quite a bit of reworking the set is required), and tube exchanges to improve performance. The third of these is worth mentioning further because it is the most useful. It's also the easiest to do.

Tube substitution of the RF amplifiers with tubes of lower noise figures greatly improves the overall noise figure of the SP-600. Replace the RF 6BA6s with a 6DC6, 6DK6, 6GM6, 6JK6 or 6GU5. The list of tubes is in descending order of equivalent noise resistance; even the 6DC6 change is a vast improvement.

OVERALL OPINION

John Bryant:

> *"My SP-600 is a completely remanufactured unit which was stripped to parts and then reassembled using as many new components (including tube sockets, all caps and resistors, etc.). It also has a new audio section (design similar to the Collins 75A4) and a new SSB module and two crystal calibrators. It's RF and IF sections for AM are stock, however. For all purposes, it is an electrically brand new unit with better audio. I am using an HC-10 unit with my SP-600.*
>
> *"With the SP-600/HC-10 combination, I have found the main receiver that I will use for fixed base DXing and for program listening for as long as I continue in radio. I have spent many hours comparing the SP-600/HC-10 with my highly modified NRD-525 and MAP combination. In almost every DX situation, the SP-600/HC-10 either wins or ties the NRD combo. Besides being as sensitive, more or less, and as selective, more or less, the vastly superior audio quality of the SP-600/HC-10 is extremely useful when trying to understand audio that is at the noise floor.*
>
> *"What this system CAN NOT offer, however, is the convenience and nimbleness that the memories and other fruits of automation bring to the major solid state receivers of the late 1980s. Personally, I think that I will continue to use something like the 525 to FIND the DX and the SP-600/HC-10 to HEAR and UNDERSTAND it."*

Having used many receivers over the years, I can truly say I enjoyed the many hours spent in front of my SP-600. As John has pointed out, it is a wonder to tune. I originally purchased my SP-600 shortly after I was married in 1976 and it was set up for DX in the 'spare room' of our house until my son was born in 1980 (thus terminating the designation 'spare room'). I did have some problems interfacing my loops with the set, and you all know that loops are a BCB DXers best friend! So I drifted away from the set in favor of a R-392, which had a built in antenna tuner; and better readout too. The SP-600 was soon sold in favor of a smaller, more compact set which fit my slightly revised DX style. In preparation for this article I obtained another set and used it head-to-head with the other radios in the shack, including two solid state sets. I was once again impressed with the performance of the SP-600; it's definitely a 'keeper'... I'm glad it's back!

I would like to thank the many SP-600 owners/users that assisted me with this article including: John Bryant, David Clark, James Goodwin, Hank Holbrook, Jef Jaisun, Bill Kleronomos, Dallas Lankford, John Leary, Pat Martin, Shawn Merrigan, Rick Setliff and Jack Woods.

I would also like to thank the organizers and editors of Proceedings for giving me this opportunity to 'hit the big time' by generating this review. They have been more than patient with all my various delays, still finding it within to encourage me to keep working. Thank you folks...

REFERENCES

[1] *GENERAL PURPOSE COMMUNICATIONS RECEIVER MODEL SP-600-JX AND MODEL SP-600-J INSTRUCTIONS,* published by The Hammarlund Mfg. Co, 460 W 34th St., New York NY (out of print I would suspect)

[2] Bill Kleronomos KD0HG,'Hammarlund Super-Pro: SP-600JX-17' and 'Update That Super-Pro' (series), *Electric Radio*, issues ??, 20, 21 and 22; P.O. Box 57, Hesperus, CO 81326.

[3] *Hollow State Newsletter* reprints are available from *HSN*, PO Box 1831, Perris CA 92572.

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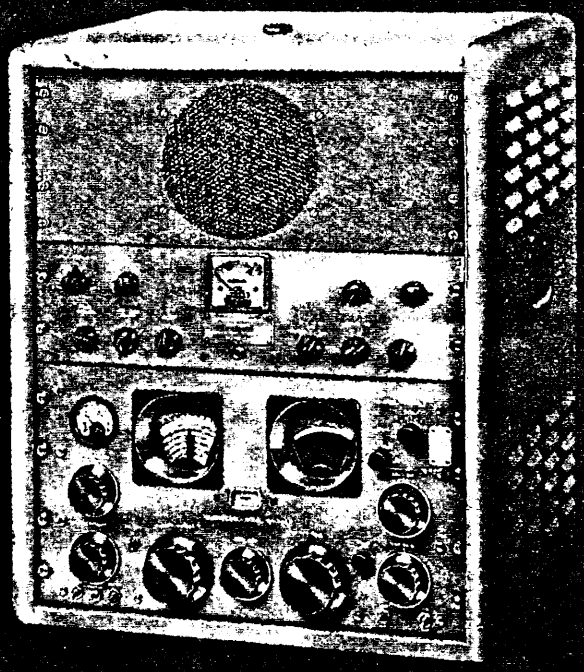
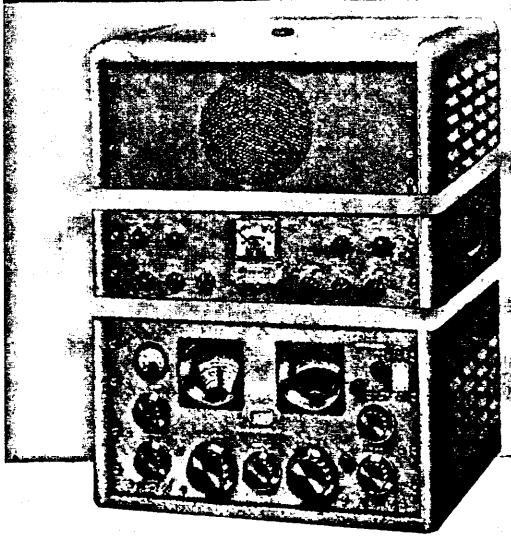
SP-600 Receivers/SPC-10 SSB Converter

For Commercial/ Military applications



The Hammarlund Manufacturing Company now offers a complete line of commercial/ military communications receiving equipment incorporating unexcelled performance and value for all communication modes from 10 KCS to 54.0 MCS. This modern Hammarlund equipment is designed in modular, or package form to enable the user to buy what he needs to meet his specific requirements, whether it is a brand-new installation, or the addition of more sophisticated performance, including SSB, to present equipment.

Hammarlund maintains a complete communications equipment engineering facility that is ready to serve you in any communications problem. The Hammarlund reputation for quality, plus the Hammarlund history for value, adds up to your guarantee for the best buy possible . . .



SPEAKER
The Hammarlund SP-300 Speaker is rack-mounted, incorporating a high-response 8" P.M., 600-ohm speaker assembly.

CONVERTER
Hammarlund SPC-10 SSB converter that may be used with any standard communications receiver having an IF frequency of 450 KCS to 500 KCS. Also adds new selectivity quality to AM/MCW reception.

RECEIVER
The world-famous Hammarlund SP-600 Series. Available in three frequency ranges for single or diversity (model SP-600-JX17) reception. In cabinet or rack-mounted units.

CABINETS
Hammarlund supplies cabinets for any combination of the above three units as enclosures for the standard relay-rack mounting units. Cabinets are completely louvered for ventilation.

1. Normal independent operation wherein the receiver is operated in conventional fashion.
2. Master Operation wherein one high frequency crystal oscillator within one receiver supplies output for the purpose of controlling the frequency of another receiver as well as controlling itself.
3. Slave Operation wherein the receiver is controlled by another receiver operating as a Master.
4. External Operation wherein the receiver obtains its high frequency local oscillator injection from an external source common to two receivers.

POINT-TO-POINT RECEPTION—With its six crystal-controlled fixed-frequencies, the SP-600 is the perfect receiver for point-to-point and network applications. Operators of these receivers can pre-arrange day and night fixed-frequencies to provide the best reception possible. By using crystal control, the operator can select a channel immediately without searching.

Whether you want to operate on a fixed-frequency for contact with an individual station or network, or roam the entire receiver range from 540 KC to 54 MC in search of other contacts, you can't operate a finer receiver than the SP-600-JX.

SPECIFICATIONS

SPECIAL DIVERSITY MODEL
SP-600-JX-17
Same as SP-600-JX except provisions for master or slave operations, i.e., internal or external H.F. oscillator, B.F.O., and adjustable A.V.C.

Standard Model Frequency Range SP-600-JX

6 Bands .....0.54 to 54.00 mc
Band 1 .....0.54 to 1.35 mc
Band 2 .....1.35 to 3.45 mc
Band 3 .....3.45 to 7.40 mc
Band 4 .....7.40 to 14.80 mc
Band 5 .....14.80 to 29.70 mc
Band 6 .....29.70 to 54.00 mc

Special Low-Frequency Models SP-600-JL and SP-600-JLX

Band 1 .....100 to 200 kc
Band 2 .....200 to 400 kc
Band 3 .....1.35 to 3.45 mc
Band 4 .....3.45 to 7.45 mc
Band 5 .....7.45 to 14.8 mc
Band 6 .....14.8 to 29.7 mc

Very Low Frequency Receiver Model SP-600-VLF

Note: All specifications same as SP-600, except the following:

Frequency Range:

Band 1 .....10 to 16 kcs
Band 2 .....16 to 26 kcs
Band 3 .....28 to 50 kcs
Band 4 .....50 to 100 kcs
Band 5 .....100 to 217 kcs
Band 6 .....217 to 540 kcs

Fixed Frequency Reception: Four crystal-controlled positions for any frequency within range of receiver.

Maximum Undistorted Audio Output Approximately 2.0 watts.

Output Impedance 600 ohms. Balanced split windings.
Phone jack-winding: delivers 15 milliwatts to an 8000 ohm resistive load, when the audio output to the 600 ohm power load is adjusted to 500 milliwatts.

AVC Action Maintains the output constant within 12 db when the input is increased 80 db.

Variable Selectivity Three crystal filter and three non-crystal filter positions provide 6 db bandwidths from 200 cycles to 13 kc.

Sensitivity 0.75 to 1.0 mv on CW and 1.50 to 2.3 mv on AM for a signal to noise ratio of 10 db.

Antenna Input Optimum coupling from a 100 ohm transmission line. Balanced doublet or single wire antenna may be used.

Double Conversion Double conversion is employed on frequencies between 7.4 mc and 54.0 mc.

Image Rejection Ratios Better than 72 db throughout the frequency range.

Beat Frequency Oscillator Variable from zero beat to 3 kc.

Tube Complement

Total—20
RF, IF and BFO Amplifiers .....7—6BA6
HF, 2nd Conversion and BFO Oscillators ....3—6C4
Crystal Controlled HF Oscillator .....1—6AC7
Mixers .....2—6BE6
Detector, "C" Bias Rectifier and Noise Limiter and Meter Rectifier .....3—6AL5
AF Amplifier and IF Output .....1—12AU7
Power Output .....1—6V6GT
Rectifier .....1—5R4GY
Voltage Regulator .....1—0A2

Vernier Log Scale 600 vernier divisions for each frequency band readable to one-tenth division making 6000 readable divisions per band.

Power Supply Requirements

Line Rating .....95, 105, 117, 130, 190, 210, 234, and 260 volt taps, 50-60 cycles. (A-25 60 cycle model is also available.)
Power Consumption .....130 watts, 1.25 amps. at 117 volts.

Tuning Meter Calibrated in db from 1 microvolt on AVC and in db from 6 milliwatts audio output.

Front Panel Equipment

Main Tuning—Vernier (combined)
Dial Lock
Band Selector Switch
Band Indicator Window
RF Gain (with On-Off switch)
AF Gain
Selectivity
BFO Pitch
Crystal Phasing
Send-Receive Switch
AVC—Manual Switch
CW—Modulation Switch
Limiter On-Off Switch
Tuning Meter
Phone Jack
Meter-Switch

Rear Panel Equipment

BFO Injection
Convenience Outlet
Balanced Antenna Input
AVC—Detector Diode Output
Balanced AF Amplifier Outlet
IF Output
AF Meter Adjustment
RF Meter Adjustment

Crystal Control For operation of the "JX" and "JLX" models on fixed frequencies above 750 Kc, any one of six channels or VFO is selected by a front panel selector-switch. Additional facilities on these models include:

Crystal Frequency Vernier Channel Chart

Dimensions Size of the cabinet model is 21½" wide, 12¾" high and 17¼" deep. Weight 87½ lbs. The rack model is 19" wide, 10½" high and 16½" deep from rack mounting surface. Weight: 66 lbs.

APD639

Specifications subject to change without notice.

SP-600 SERIES RECEIVERS

No communications receiver has ever established a record for performance and dependability such as that of the Hammarlund SP-600. It is used throughout the world for military, commercial, and amateur users. It compares with receivers costing far more, and now, through the addition of the Hammarlund SPC-10, offers operational features exceeding virtually all other receivers at any price.

The SP-600 communications receiver is a 20-tube dual conversion superheterodyne, available in three frequency models ranging from 10 KCS to 54.0 MCS. Receiver frequency ranges are listed under **Specifications.** It contains its own power supply. Operation of any one of six crystal controlled fixed frequency channels within the range of the receiver is immediately available, while variable tuning of the receiver range is accomplished over six continuous bands. Stability is excellent, ranging from .01% or better at 540 KCS to less than .001% at 54 MCS. Image rejection is 74 db down, and spurious responses are at least 100 db down. Sensitivity is a maximum of 1 microvolt CW and 2 microvolts AM. Selectivity for the three crystal and non-crystal filter positions is from 200 cycles at the narrowest bandwidth to 13 KCS at the broadest bandwidth. Radiation is negligible with no cross-talk in multi-receiver installations.

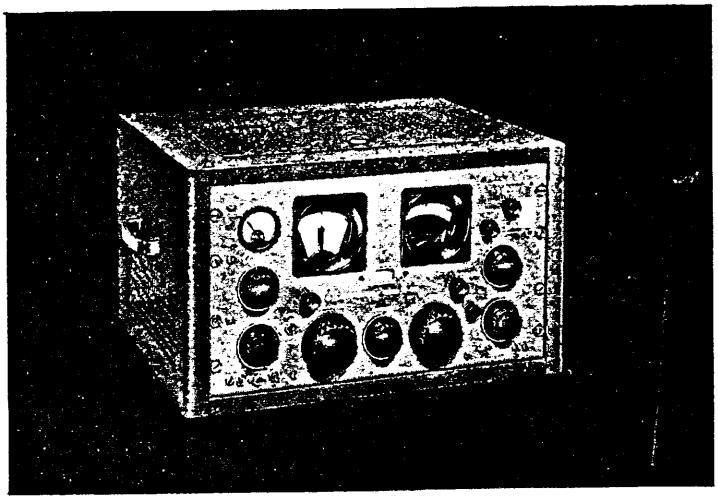
MECHANICAL DESCRIPTION—This 20-tube radio communications receiver is supplied in either a well-ventilated steel cabinet finished in dark gray to complement the lighter gray front panel, or for mounting in a standard 19" relay rack. Power input requirement is 130 watts. The standard power supply has taps to permit operation from various power sources, 90 to 260 volts and 50/60 cycles. A 25-60 cycle power supply model is also available.

The standard model covers a frequency range of 540 KC to 54 MC divided into six bands operated by a band selector switch on the front panel. A special low frequency model with a range of 100 to 400 KC and 1:35 to 29.7 MC is also available.

The single tuning control is massive and of special design to permit maximum traverse speed as well as operating ease. It controls both the main and vernier dials. An anti-backlash gear-train provides extremely close calibration accuracy (0.25% or better) and accurate resetability.

The ratio of the vernier dial to the main dial is 6 : 1 and the tuning control to the main dial is 50 : 1. Approximately six complete revolutions are made by the vernier dial while the main dial makes its complete band coverage. An arbitrary outer scale on the main dial indicates the revolutions made on the vernier scale in each particular band. The vernier scale provides 100 major divisions with half division markers for individual station logging. Because it is easy to estimate 1/10 divisions on the vernier scale, this system makes it possible to divide each frequency band into approximately 6000 readable settings.

A tuning lock provides for positive locking action without affecting the frequency setting. A band indicator window on the front panel shows the frequency range of the band in use, and at the same time, a dial frequency indicator is aligned with the proper dial scale.



ELECTRICAL DESCRIPTION—A two scale tuning meter is used on AVC operation. Normally this meter indicates the accuracy of tuning and the relative strength of received signals in db from one microvolt. Depression of the front panel meter switch converts the meter circuit to indicate output level in db from 6 milliwatts.

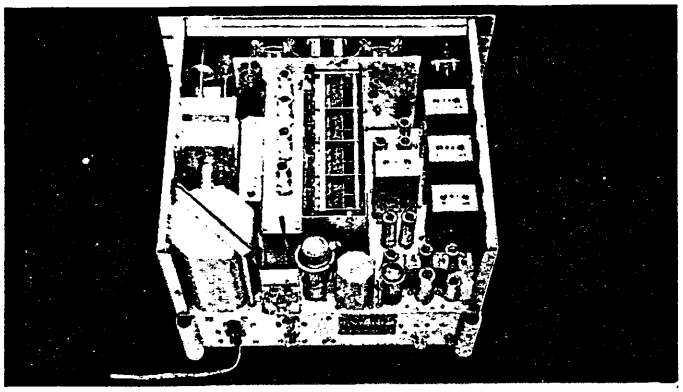
The RF gain control is provided for manual control of sensitivity to prevent over-loading by strong signals when operating with the AVC-Manual switch in the Manual position. This control also operates when the switch is in the AVC position.

The Send-Receive switch desensitizes the receiver but leaves the power on to provide for instant reception between transmission periods.

The circuit for single conversion, used for signal frequencies up to 7.4 MC, consists of 2 stages of RF amplification, first-mixer, first heterodyne oscillator, four stages of IF amplification, detector and AF amplifier and output power stage. The power supply system includes power rectifier, bias rectifier and voltage regulator. The circuit for double conversion, used for frequencies between 7.4 MC and 54.0 MC, employs a 2nd mixer and crystal controlled 2nd heterodyne oscillator in addition to the stages used for single conversion.

Due to double conversion circuits, images are practically nonexistent in the receiver. Image rejection varies between 74 db and 120 db, depending on the band.

An ingeniously designed rotary turret is employed to change bands and to place the coil assemblies of the RF amplifier, mixer and first heterodyne oscillator stages directly adjacent to their respective sections of the four-gang tuning capacitor and their respective tubes. This assures maximum sensitivity at high signal to noise ratio.



The AVC circuit is provided with separate time constants for CW and MCW operation and the tubes employed are used as a high level detector and AVC rectifier.

The beat frequency oscillator employs a high capacity Colpitts circuit which gives excellent frequency stability and minimizes oscillator harmonics. It is connected into the detector through a buffer amplifier which eliminates oscillator lock-in and permits variation of the beat oscillator injection by means of a control located on the rear of the chassis. A front panel control varies the audible beat frequency from zero beat to plus or minus 3 KC.

The noise limiter circuit limits the interference from electrical equipment or other sources of pulse type noise, such as ignition noise. A control switch permits optional use of the limiter on any mode of operation when pulse type interference is present.

A resistance coupled triode amplifies the audio frequency signal received from the detector. The audio output tube is transformer coupled through a split balanced winding to deliver 2.0 watts of undistorted output to a 600 ohm load. A separate secondary winding provides attenuated audio signal output for headphone operation. Radiation is negligible and complies with requirements for shipboard operation and for multi-receiver installations.

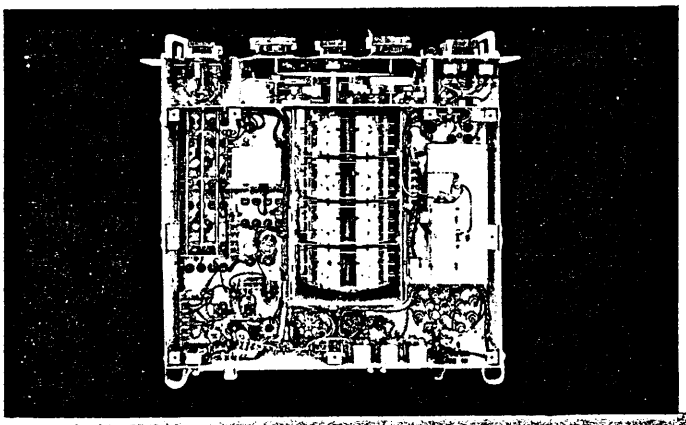
Frequency drift after a 15 minute warmup varies between .01 per cent at the lower frequencies to .001 per cent at the highest frequencies. This is a frequency stability previously unattainable in any but crystal controlled circuits.

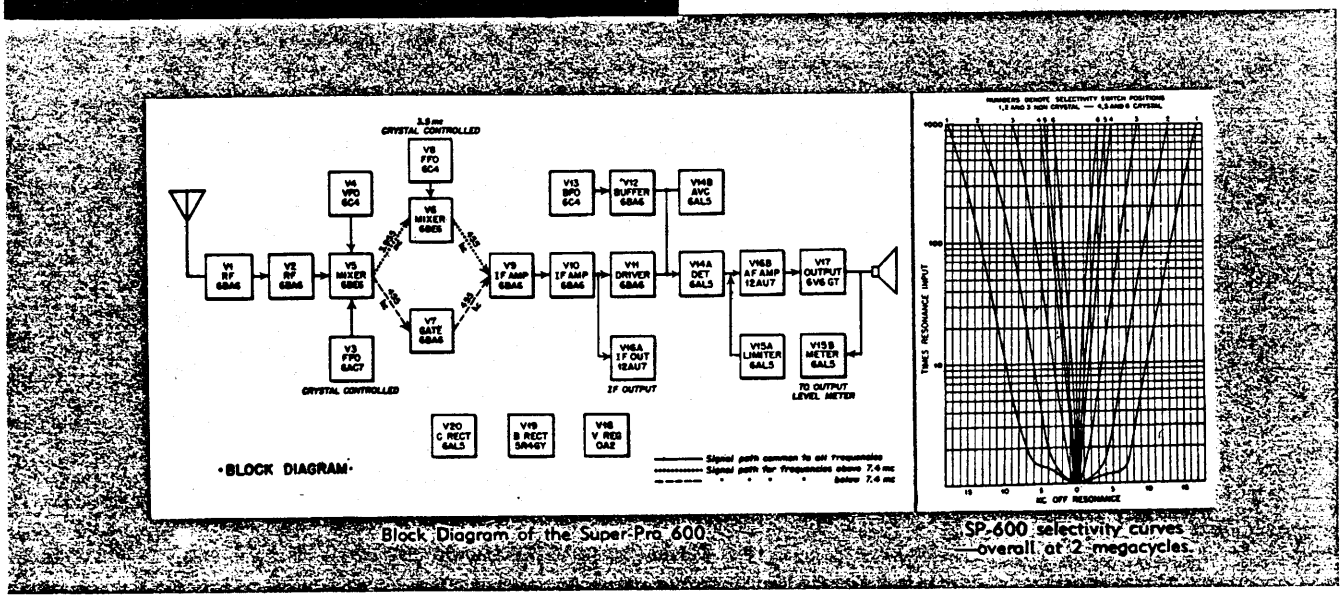
Remarkably uniform sensitivity over the entire frequency range is maintained between 0.7 and 1.0 microvolt in telegraph communications and from 1.2 to 2.0 microvolts in voice reception. This sensitivity is measured to a 10-1 signal-plus-noise to noise-power ratio.

DIVERSITY RECEPTION—The SP-600 is designed also for use in a diversity reception system designed to enhance the quality of the communication link whenever the receiving conditions cause signal fade. In this case two or more of the receivers are used in close proximity to each other. The spatial separation of the receiving antennas provides a higher probability of a usable signal from at least one receiver at a given time. Space diversity receiving systems provide distinct improvements of high-frequency radio transmissions.

Each receiver has a cable connector to provide the received signal as IF output for space diversity system use. Radio transmissions as CW and single-tone modulation are used for Morse code operation while two-tone and frequency-shift modulation are used especially for teletypewriter operation.

While the standard model can be used in this way in a diversity system, a special model is also available. This model is designed to accomplish the following modes of operation.





Block Diagram of the Super-Pro 600

SP-600 selectivity curves overall at 2 megacycles.