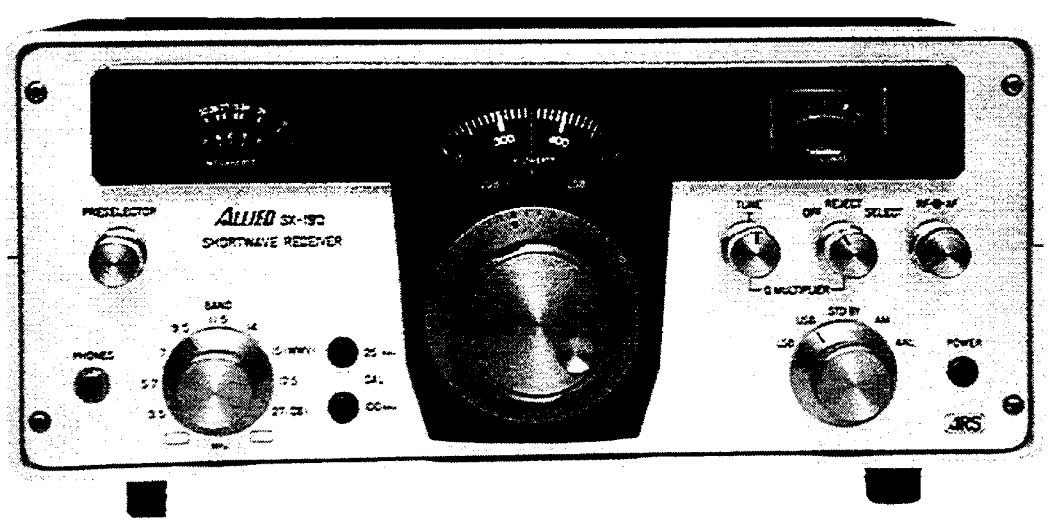
Allied AX/SX-190 Receiver

Resource Collection

Compliments of Mark Rehorst

- Ad for AX/SX-190 from Radio Shack catalog
- Ad CQ Magazine, May 1972
- 73 Magazine Review
- CQ Magazine Review, May 1972
- NASWA Consumer Report, by Ed Shaw
- QST Magazine Mods, by Paul Dujmich
- CQ Magazine Mods, March 1973, by Bruce Mackey
- Bandswitch Mods, by John Kolb
- NASWA-FRENDX upgrading the SX-190, May 1974, by Ed Shaw
- Comprehensive Technical Manual, by Ed Shaw
- Miscellaneous Reviews and How-to's thru 1982
- Allied Radio Shack Service Manual
- Allied Radio Shack Instruction Manual



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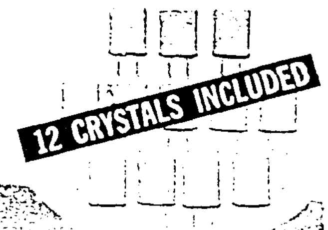

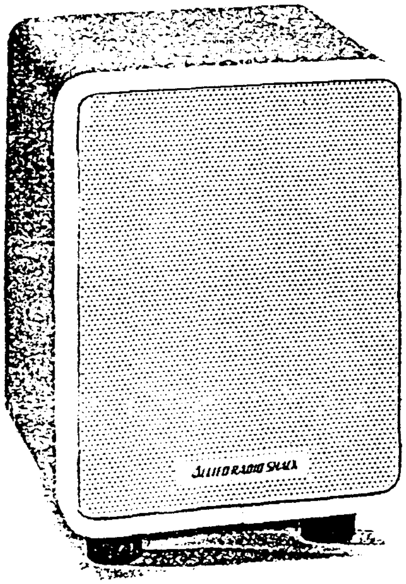

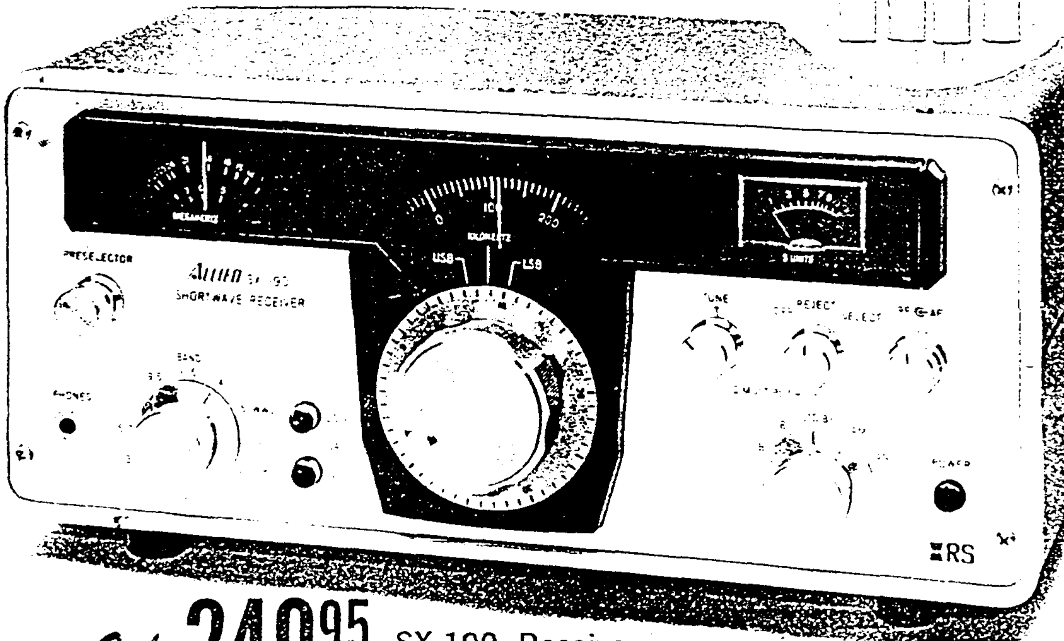

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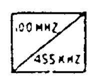

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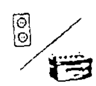

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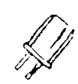

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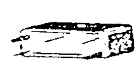

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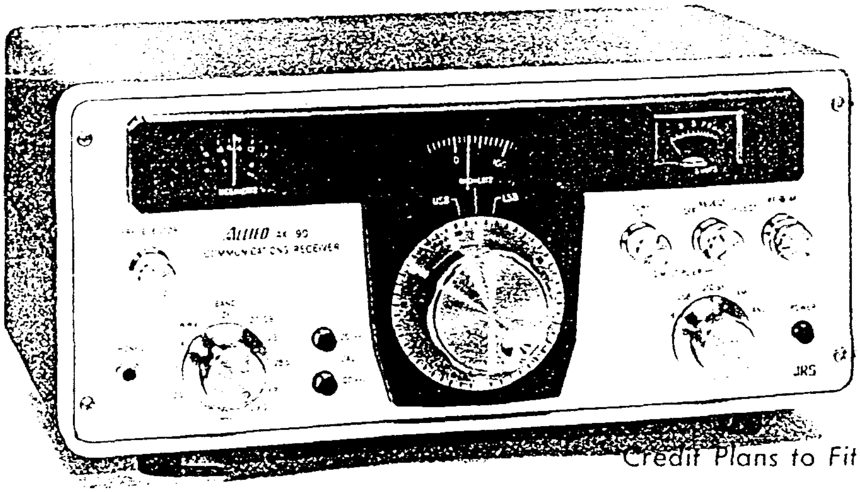

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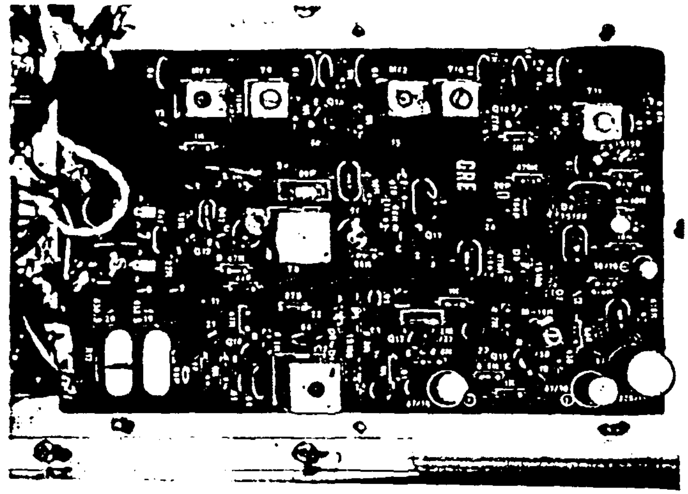
73 Reviews The Allied AX-190 Ham Receiver



If all receivers preformed as well as they looked, a ham would It have no trouble in obtaining a good one. The trick is finding the good receiver that is behind the pretty panel. The Al lied AX-190 is such a one.
Behind the brushed aluminum front are five printed circuit boards that hold all components in very neat arrangements. On one of them is a four FET front end, which is rated at 0.5uV sensitivity at 10 dB S/N. Our test unit performed very well with no more than a longwire, and we have no reason to doubt the accuracy of the manufacture's statement. This receiver picked up many weak stations that other radios could not hear. The preselector is very sharp and sensitive and really peaks up signals while rejecting interference from strong off-frequency stations. The receiver covers eighty through all of ten meters in 500kHz bands. There is also provision for adding another segment of the 3.5-10MHz ranges.

For those strong signals that cause QRM, the Q-Multiplier does an excellent job of elimination heterodynes and peaking the desired signal. This feature is certainly a desirable one for CW and SSB ops. Signals here were raised by thirty to forty decibels, and when the rejection mode was selected, annoying whistles were eliminated.

CW and SSB are received well by means of a four diode balanced modulator circuit. The first oscillator and bfo are crystal controlled for sharp and accurate tuning. The audio is clean and pure, and almost hi-fi in short, very comfortable. Dual conversion and ceramic filter add measurably to easy listening.

For those who might want to listen to AM stations that are outside the ham bands, an AM position and AM with ANL are provided on the function switch. Incidentally, the diode noise limiter performs very well to take out ignition and electrical noises (i.e.. the fluorescent light on my desk).

As for minor features that add to the pleasure of owning the AX-190, there is a 25 and 100 kHz calibrator for accuracy of the smooth tuning knob, which has one kilohertz markings on the resettable skirt. The rig also has provision for operation directly off of 12V dc, making the rig valuable for mobile, Field Day, emergency, and portable use. Antenna input is a common SO—239 chassis connector, provision for muting, and vfo output round out the features of this receiver. One other valuable feature of the rig is the accompanying instruction manual. It is complete with an excellent theory of operation section that includes excerpts of the complete schematics showing the various stages in their individual and combined design states.

For the ham who is looking for a good receiver., portable, or emergency receiver at $249.95 this receiver needs careful consideration. Novices in particular should keep in mind that a few extra dollars on the receiver purchase can add proportionally greater enjoyment to his operating experiences. And when upgrading his license, this receiver will keep its value in the station.

CQ Reviews...

The Allied Radio Shack Series 190 Receivers

BY WILFRED M. SCHERER,* W2AEF

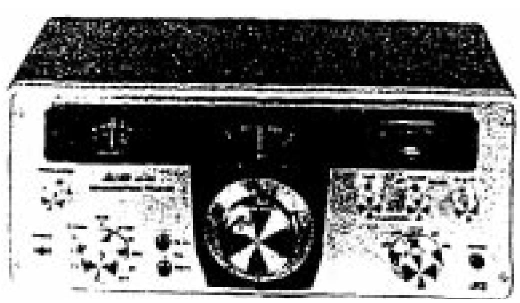
ALLIED Radio Shack has recently introduced two dandy low-cost solid-state receivers that embody some of the finest Japanese craftsmanship we've run across. There are two models.

The AX-190 is primarily an amateur-band receiver providing full coverage of the 3.5-28 MHz amateur bands, the 15.0-15.5 MHz s.w. band for WWV, the 27 MHz Citizen's Band, with the addition of an auxiliary spare position for use in any one 500 kHz segment between 3.5 and 10MHz.

The SX-190 is primarily an s.w.l. short-wave broadcast band receiver covering the s.w. bands of 5.7, 7.0, 9.5, 11.5, 15 and 17.5 MHz plus the Citizen's Band and the 3.5 and 14 MHz amateur bands (7 MHz band is included in the s.w. BC range). In addition, there are two auxiliary spare positions one for use between 3.5-10 MHz, the other for between 10-30 MHz.

Except for the different bands, both models are otherwise identical, with the following features: a.m., s.s.b. (u.s.b. or 1.s.b.), c.w. reception; 4 kHz selectivity, Q-Multiplier for peaking or rejection-notch; r.f. preselection tuning; linear frequency-tuning rate with calibration in 1 kHz increments over a 500 kHz segment for each band; 100/25 kHz crystal-controlled calibrator; S-meter; a.g.c.; am. noise limiter; r.f. and a.f. gain controls; v.f.o. and h.f.o. outputs; line/tape-recorder output; separate headphone and speaker jacks; operation from a 117 v.a.c. or 12 v.d.c. power source with built-in facilities.

*Technical Director, *CQ*.



The Allied Radio Shack AX-190 amateur-band receiver. Except for the different bands, the Model SX-190 s.w. broadcast-band version is identical.

Technical Data

The receivers have a complement of 4 FET's, 22 bipolar transistors, 13 diodes plus 2 zener diodes and 2 thermistors. Referring to the block diagram at fig. 1, double conversion is employed with a variable 1st i.f. of 2420-2920 kHz and a fixed 2nd i.f. of 455 kHz.

Referring ito fig. 2, the r.f.-input amplifier is rather unique. It consists of two FET's in a cascode configuration using three individual r.f. circuits for preselector-tuning. Two of these circuits are at the input of the r.f. stage where they are coupled to each other through a resistive attenuator consisting simply of a potentiometer. The third tuned circuit is at the output of the r.f. stage. Use of the three circuits, instead of the customary total of two, ensures better r.f. preselection for higher image and i.f.-signal rejection as well as that of other unwanted input signals.

Extremely sharp preselector tuning is had with image rejection on the AX-190 measured as 90, 78, 74, 60, 50 db and i.f. signal rejection as 50, 70, 90, 105, 100 db on the 3.5, 7,14, 21 and 28 MHz bands respectively. Similar results were also obtained on the nearest related s.w. bands with the SX-190.

I.f.-signal rejection (of the 1st i.f.) is further enhanced by a bandpass filter at the antenna input. The preselector has two ranges, one is 3.5-10 MHz, the other is 10-30 MHz. The preselector dial calibration is exceptionally accurate accordingly.

Another novel arrangement at the r.f.

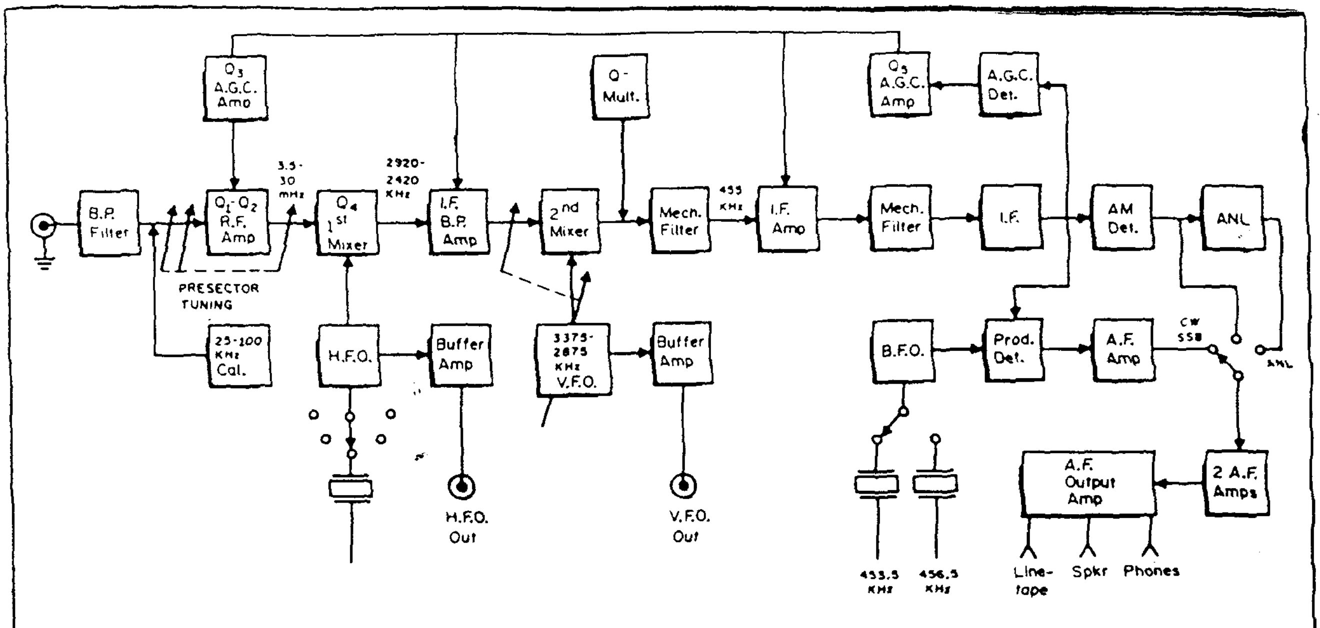


Fig. 1—Block diagram for the AX-190 and SX-190 receivers. Details are given in the text.

stage is the r.f. gain and the a.g.c. setup. The a.g.c. is obtained from voltage doubling diodes at the last i.f. stage. The rectified r.f. is then applied to a transistor d.c. amplifier at the collector of which is obtained the a.g.c. potential from the arm of control R_2 which is ganged with the arm of R_1. The a.g.c. potential is applied to the base of transistor Q_3 the collector emitter junction of which is in series with the source resistor of the first FET (Q_1).

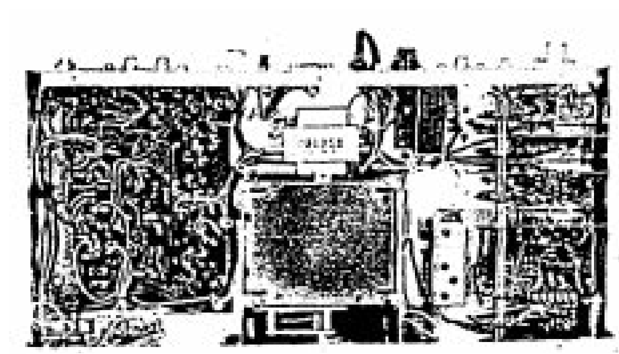
Changes in the a.g.c. potential applied to Q_5 then cause its collector/emitter resistance to vary accordingly and since this resistance is in the source circuit of the FET, the gain of the latter similarly follows the a.g.c. changes.

For reducing the r.f. gain, R_2 is rotated toward the ground end. The fixed bias (from Q_5 collector) applied to Q_3 then changes, reducing the bias on the FET and thus its gain. At the same time, R_1 rotates toward its ground end, reducing the coupling between the first two tuned circuits.

A.g.c., also applied to the 2nd mixer and the 1st 455 kHz i.f. stage, is handled in the conventional manner.

The S-meter responds instantaneously, since it is located at the emitter of the a.g.c. d.c. amplifier where the time constants of the a.g.c., which are located at the output of the amplifier, have no effect on the operation of the meter. The a.g.c. attack is exceptionally fast without any evidence of distortion or harshness on the attack with s.s.b. signals. The release time, however, is a bit fast for s.s.b. use and there are some pumping effects when background noise is present. The a.g.c. characteristics otherwise are such as to hold the a.f. output level within 12 db with r.f. input changes of 100 db (1-100,000 uv).

The 1st mixer is an FET with the r.f. signal applied to the gate, the heterodyning-oscillator signal to the source. The oscillator is crystal-controlled using a bipolar transistor. The crystal frequencies are equal to 2.920 MHz plus the frequency of the low end of the desired r.f. signa1 range. For crystals below 17.920 MHz the oscillator is tuned to the fundamental frequency; for higher-frequency crystals it is tuned to the 3rd overtone. An emitter-follower buffer amplifier, after the



Bottom View of the AX-190. Lower part of the box for the v.f.o is at the center

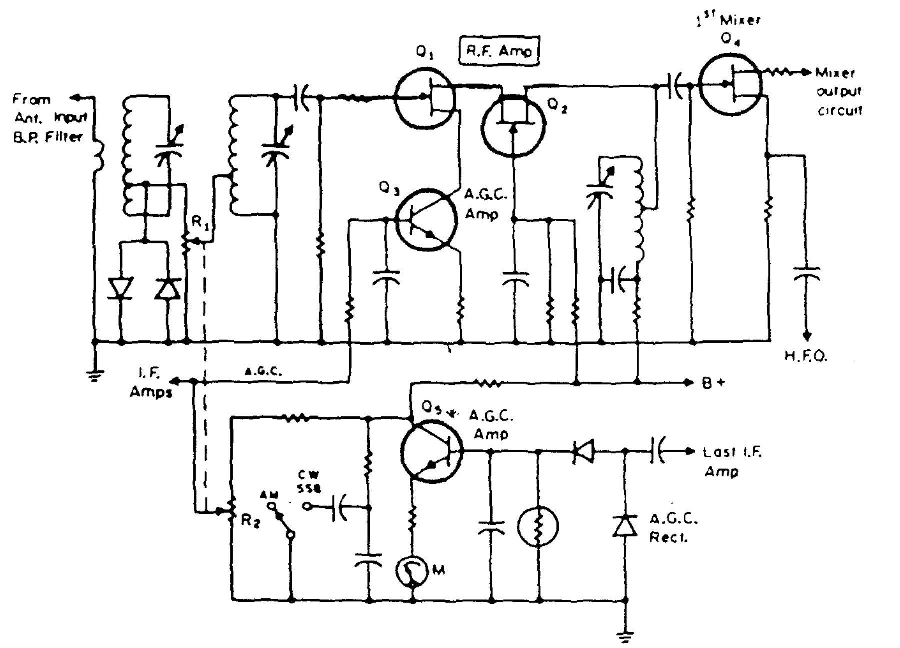


Fig. 2—Front-end and a.g.c. circuitry of the AX-190 as described in the text.

crystal oscillator, feeds an h.f.o.-output jack on the rear of the set.

A 2920-2420 kHz amplifier precedes the second mixer. It has a fixed bandpass circuit along with a tunable bandpass-coupled circuit ganged with the v.f.o .-tuning control. The 2nd mixer is a bipolar transistor with both the r.f. and v.f.o. signals fed to the base.

The v.f.o. functions from 3375 to 2875 mHz and employs an FBI with a tuned-gate circuit. Output is taken from the drain. As with the h.f.o., an emitter-follower buffer feeds a v.f.o.-output jack.

There are two 455 kHz i.f. stages each with an individual mechanical filter at its base input. Two other transistors at the i.f. input make up the Q-multiplier.

A diode envelope detector for a.m. feeds a series-gate noise limiter. The s.s.b./c.w. product detector is a four-diode ring type feeding an additional amplifier ahead of the normal a.f. amplifying chain which ends up with an n.p.n. and p.n.p. transistor in a Darlington configuration with individual output jacks for speaker or headphone use. The “undistorted” a.f. output with this set-up measured 0.5 watts at 300 Hz and 0.75 watts at kHz.

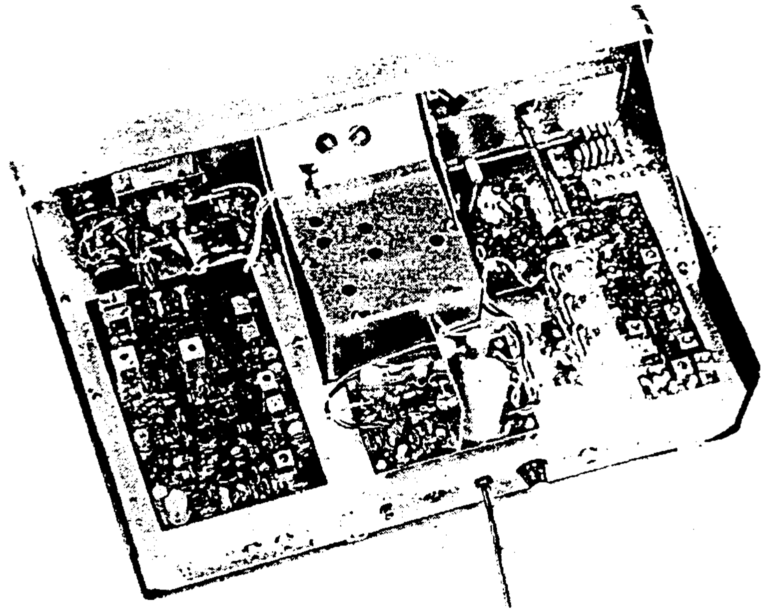
The b.f.o. is crystal-controlled with either a 453.5 or a 456.5 kHz crystal switched in for u.s.b. or l.s.b. operation as the need requires. The 3 kHz change is not compensated at the v.f.o., so the receiver must be retuned 3 kHz when sidebands are changed. The 455 kHz i.f. section has a passband of 4 kHz at 6 db down and since the b.f.o. crystals are only 3 kHz apart in frequency, the reinserted carrier then falls within the i.f. passband near the side of the selectivity curve required for u.s.b. or 1.s.b. selection as the case may be. This spot is hardly down the selectivity curve, with the result that the unwanted-sideband suppression at 1 kHz is only 12 db.

The Q-multiplier peaking position is somewhat broader than usually experienced, but it can be used to improve the sideband suppression to 16 db without deteriorating the intelligibility of an s.s.b. signal as otherwise would result in too sharp a peaking characteristic. The Q-multiplier rejection position provides a 20 db notch, but the rejection curve is quite broad and thus lowers much of the desired passband by 10-14 db.

The calibrator employs a 100 kHz crystal oscillator that drives an amplifier, which is coupled, to the antenna input to provide marker signals at 100 kHz intervals. For 25 kHz signals, a multivibrator is switched in between the oscillator and the amplifier.

The a.c.-operated power supply employs silicon diodes in a full-wave rectifier followed by a transistorized voltage-regulating setup. For operation from a 12 v.d.c. source, the input of the regulator is switched from the rectifier output to a d.c.-input connector. Overload protection is provided by a 1A fuse at the regulator input.

The v.f.o. and variable-i.f. band-pass tuning circuits are in the box at the center. In the center fore-ground is a board with the a.f. section and power-supply components. At the right of the v.f.o. is the calibrator board. The r.f. circuit board is at the right with the h.f.o. crystals at the upper-right corner. The three-gang preselector-tuning capacitor is at the left of the board. The i.f., b.f.o. and detector sections are on the board at the left. Brackets at each end of the panel and at each side of the v.f.o. box provide firm bracing to the chassis.



Construction

The 190 receivers are built using several individual printed-circuit boards for various sections of the set. Resistors and capacitors are identified on the boards by value, while other components are designated by schematic number, facilitating circuit tracing should servicing become necessary. This also may be aided by following the circuit runs which are indicated in black on the component side of the boards.

The boards are installed on a heavy-metal chassis with a satinized aluminum-finish panel and knobs. Pushbuttons are engaged for power on-off and the calibrator operation. Quite a few brackets between the panel and the chassis provide bracing that gives exceptional sturdiness to the whole setup.

A large black escutcheon is behind the tuning control dial and runs across the top of the panel where it has a full-length elongated window behind which are the S-meter, a calibrated dial for the preselector and the maintaining dial for the receiver frequency. The latter is a circular one calibrated in 10 kHz steps. The tuning control has a dial calibrated in I kHz steps spaced 3/16" apart over a 50 kHz range for one revolution. This dial can be slipped on its shaft for indexing to the calibrator signals. A finger hole is provided on the face of the tuning knob to make rapid excursions over the range easily possible.

The phone jack is on the panel, the speaker jack is at the rear. Terminals for remote standby control also are at the rear along with phono jacks for line/tape and oscillator outputs. The receiver is housed in a dark gray wrap-around type case consisting of top and bottom half-shells.

Operation and Performance

The receivers are nice looking jobs with a solid feel to them. There is no flimsiness about them as often experienced with some of the low-cost Japanese-built gear. The tuning is quite nice; however, the finger hole in the tuning-control knob might have been made deeper to prevent one's finger from slipping out of it during fast tuning.

A mode switch selects a.m., a.m. with a.n.l., l.s.b. or u.s.b. (s.s.b./c.w.). Since when side-bands are switched the receiver must be retuned 3 kHz, there are three individual hairlines at the dial fiducial for keeping track of the receiver calibration in each mode of operation. The reference line for a.m. is at the center, to the left and right of which are those for u.s.b. and l.s.b. respectively.

Besides some of the statistics and the performance comments already mentioned in the text, others are as follows:

The sensitivity of the receivers measured an average of 0.25 uv for 10 db S+N/N on s.s.b. and c.w. and of 0.5 uv on a.m. Band-to-band gain, referred to 14 MHz, was ±4, +13, ±5, + 1 on the 3.5, 7, 21 and 28 MHz bands. An average of 100 uv was required for an S9 meter reading on all bands. signal-handling capabilities (cross modulation, r.f. inter-modulation, overload, etc.) were somewhat better than jobs using bipolar transistors, but not up to the more sophisticated ones using FET's.

Care must be taken to set the preselector at the proper point; otherwise, signals at other spots may be tuned in which are different-than-normal desired-mixing products of the receiver that may occur in conjunction with the v.f.o. or its harmonics.

Fortunately, because of the extremely high selectivity provided by the three preselector circuits, these products are not encountered with proper adjustment to the desired frequency indicated by the accurate calibrations of the preselector dial.

S.s.b. signals are easy to tune in and sound good in spite of the lower-than-usual unwanted-sideband rejection capabilities of the receiver. To the critical trained ear, however, a slight degree of distortion may be noted partly due to the above, a slightly fast a.g.c. release and a less-than-optimum b.f.o. to signal ratio at the product detector. The latter can be corrected, however, by adjusting the b.f.o. output (at T12) for minimum a.f. distortion of a 100-200 Hz beat note observed on an oscilloscope at the a.f. output of the receiver. The a.m. quality is exceptionally good, resulting in excellent intelligibility, a particular boon for those interested in s.w. broadcasts.

The results of several frequency stability runs indicated an average one-half hour warmup drift of 500 Hz with a drift of 250 Hz or so per hour thereafter. No change was noted with ±10% line-voltage variations. Vibration tests produced no adverse effects on the frequency stability.

Setting up one of the auxiliary ranges requires installation of an appropriate crystal and a trimmer capacitor for which provisions are already made on one of the circuit boards. No changes or additions are needed at the preselector tuned circuits. As noted earlier, with the AX-190 the one auxiliary position is available for use in a 500 kHz segment only in the 3.5-10 MHz range, but for those not interested in the CB range, the crystal for this position may be changed to one for use in another segment between 10-30 MHz. On the other hand, users of the SX-190 who may desire to add coverage of the 21 MHz amateur band and one segment of the 28 MHz one, while still retaining the other amateur bands and the s.w. broadcast ones, can do so by changing the CB range over to 21 MHz and using the 10-30 MHz auxiliary position for the 28 MHz segment.

All in all, the AX-190 and SX-190 receivers are excellent jobs selling for $249.95. We suggest you see for yourself by looking them over at one of the hundreds of Allied Radio Shack stores for whom the receivers are custom-manufactured.
- W2AEF

ALLIED

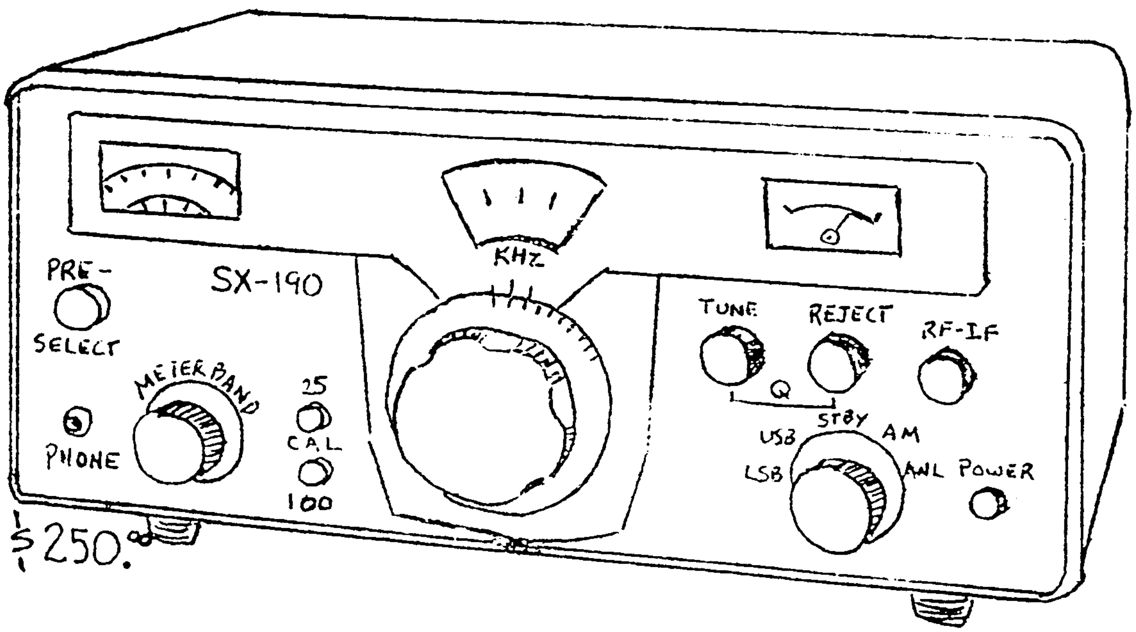
SX-190

A

S P E C I A L

NASWA

PUBLICATION



by

Edward C. Shaw

Acknowledgments: Mr. Paul Stanley, Allied Radio Shack, Fort Worth, Texas; Mr. Gene Welch, International Crystal Mfg. Co, Oklahoma City, Oklahoma; Mr. Al R. Niblack, North American SW Assn, Vincennes, Indiana. This publication is free of charge.

ALLIED SX-190 RECEIVER
A Consumer's Report

by Edward C. Shaw

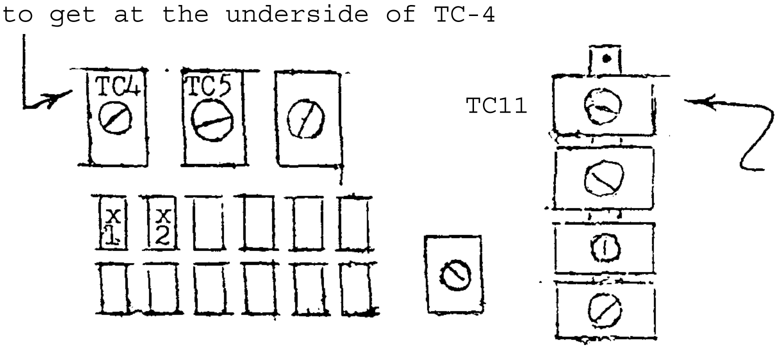
The SX—190 receiver is a solid—state, crystal controlled short wave receiver with a dual—conversion circuit. This means that images are not likely to appear as in other single—conversion receivers. The circuitry provides reception of 11 short wave bands from 3.0 to 30.0 MHz.

The advertised coverage of 3.5 to 30 MHz is misleading and not quite correct, in that a crystal may be purchased which will allow the receiver to be used for reception of the 90-meter short wave band. The initial advertisements were probably written by promoters who didn't realize there was anything of major interest below 3.5 MHz for amateur or foreign broadcasting. There are a number of low—powered SWBC stations in the vicinity of 3.2 to 3.4 MHz, notably Latin's and some Africans, as well as CHU on 3,300 kHz.

The receiver comes equipped with provisions for the 75, 49, 40/41, 31, 25, 19, 20, 16, and 11-meter (CB) bands. Extra accommodations may be purchased for any other 500 kHz segment between 3-10 MHz, and for any 500 kHz segment between 10—30 MHz, for a total of 11 bands. One might best choose to fill the lower option with a crystal for the 60-meter band, and to fill the upper option with a crystal for the 11-meter band. The process is quite easy and not as complicated as the manual intimates. If, however, the reader is not inclined to electronic work with a soldering gun, a 60-meter crystal may be put in the 75-meter crystal place without change in capacitance. But, since there is little of interest to the majority of SWLs on 90 meters (except to the most hard—core DXer), it is recommended the lower option be filled with the 60-meter crystal, installing it with the needed capacitor. In the upper option, a 13-meter crystal may be added without additional capacitance, but may perform a wee bit better if a 40pf capacitor is installed across the terminals of TC—11. The only time the author actually had to use a capacitor was for the 90-meter crystal and that was located in a position underneath the chassis, which luckily was easiest, and cost accessible place it could have been.

For convenience of the reader to locate the concerned crystal sockets and trimmer capacitors, a pictorial diagram is provided here of the interior of the SX—190:

Remove bottom of receiver chassis
to get at the underside of TC-4



Remove screws from trimmer
strip, and carefully lift
up whole strip to expose
underside of TC—11

X-1 is the blank option space, which will require extra capacitance in parallel with TC-4 trimmer (across the terminals). If the reader chooses to put a 60-meter crystal in this spot, the needed extra capacitance will be 510pf. If a 90-meter crystal is chosen, a 680pf capacitor will be needed. Actual tolerances are not critical and capacitors may be a little larger or smaller, about 10% either way.

The reader can readily be guided by how the capacitors for other crystals are installed when it comes time to install his own, but be sure the terminals you locate on the underside of the chassis belong to the socket or trimmer concerned as seen from the top.

X—2 is the space, which already contains a 75-meter (3.5 MHz) crystal when bought. This crystal may be removed and a 60-meter crystal put in its place without changing capacitors. The capacitance for the one is near enough also for the other. This is the easiest and simplest method to attain 60-meter coverage — far more important and productive than 75-meter coverage, in the opinion of the author. 60-meter coverage is the most widely used band in the world. On it can be found nearly any country you desire. Although somewhat inconvenient to remove the metal cabinet top each time, you can always exchange one crystal for the other at any time you want to go back to 75 meter coverage for some reason, In this case, you may need to touch up trimmer TC—5 with a small screw driver just a tad to bring your dial into exact alignment. The trimmers are used for subtle alignment of 2—3 kHz either way to perfectly align your dial.

X—11 is the upper blank option. The 13-meter crystal may be put in this socket without capacitance, or it may require a small 40pf capacitor across the terminals of TC—ll.

* * * * * * *

In particular, the author is pleased with the performance of the 60-meter crystal. All extra crystals were ordered by mail from International Crystal Mfg. Co. in Oklahoma City at a very reasonable price — at a 25% savings under Allied’s price. To labor on this point a bit, Allied nominally takes one or two months to provide crystals. Also, a half dozen known instances concerning Allied crystals revealed the wrong frequency when the crystals arrived. International took only 10 days — and the quality of the crystals were first rate. It is recommended that owners of the SX—190 purchase the 60-meter and 13-meters crystals. The crystals needed are described on a sample order blank made for your convenience on the next page. Be sure to line out those crystals not desired on the order blank.

SX-l90 PERFORMANCE

The first weeks the author had his receiver were a nightmare. The receiver was plagued by failures, strange noises, and low sensitivity. After the third trip back to the dealer’s technician, it was finally determined that the problems were cold solder joint breaks. After touching the tip of soldering gun to a few points here and there, the receiver really came to life. Several other cases brought to Allied Radio’s attention prompted Mr. Paul Stanley, of Allied’s Technical staff in Fort Worth, Texas, to investigate the receiver thoroughly. Cold solder joints were the problem he found - specifically in the VFD oscillator section. During manufacture, parts were evidentially not being pushed down far enough through the circuit board to make proper soldered connections beneath: which resulted in some broken contacts in the shipping process. The technician hired by the author to align his receiver thoroughly tested the receivers specifications and found that, after alignment, the lower range (3.0 to 10.0 MHz) generally required less than 1/2 microvolt for 10 db down on Single Side Band modes, and less than 1 microvolt on AM mode. The readings f or the upper range (10—30 MHz) was insignificantly better. These excellent readings are just about the limit that any person could reasonably expect from most receivers on the market today under $500.00. A good technician can also sharply tune your Q- multiplier until it literally rings sharp as a bell and does an outstanding job of shaving off QRM (quieting) on either side to let you copy that difficult signal sometimes found deep in the mud.

The SX—190 comes equipped with some features found only on the most expensive receivers: or only available as an external additive. The built—in Q—multiplier and selectivity control is a marvel. Even without use of that control, stations are usually easily separated every 5 kHz, except the most stubborn cases involving very powerful or deliberately "splashy" signals such as from Havana and others. Using the Q-multiplier, I have separated very weak stations only 1 kHz apart. Admittedly, this comes with some practice. You cannot get away from the annoying squeal of heterodyning, however, when stations are that close together, but this author is well pleased with the selective quality of the SX-190. It compares favorably with the more expensive Drake and Collins line — both of which the author has tuned. Hallicrafters or Hammarlund equipment cannot approach such accuracy with the same ease.

STABILITY: After a few minutes warm up, the SX-190 could not be caused to drift, even after violent shaking, and accidental dropping from about 18 inches off the surface of a desk (not advised deliberately). The desired frequency remains stable after switching the mode switch and the band selector and then returning. Superb!

QUIETNESS: This is a solid—state device. As is inherent in all solid—state devices, there is a higher internal thermal noise level than with tube type receivers. This is recognized as an audible s—s—s—s—s sound. Some persons may detect a quiet hum, too, but so quiet as to be inaudible to others. This is a 120-cycle hum resultant from combining both hot sides of your AC line in the rectifier bridge, but the filtering is well designed to null this hum to practically nothing. When the SX—190 is operated on DC (battery) power, the hum completely disappears.

POWER SUPPLY: Performs on standard house current as well as any 12 volt DC source, such as automobile cigarette lighter plug, or battery pack made of standard "D" size flashlight cells, available from Radio Shack. It is recommended that owners of SX—l90 do NOT buy the relatively expensive battery pack, which is a poor value in the author’s opinion. All you need are two 6 volt dry cells at $2-$3 each at any hardware store. Not only are they cheaper, but also they will far, far outlast your flashlight battery pack. CAUTION: Be absolutely certain that your battery polarity (+ and —) is correct before hook—up to your receiver, Even though the circuit is protected by diodes in case of erroneous hook—up, the system might fail at sometime and an erroneous hook—up may possibly destroy any number of your solid—state devices, a very costly mistake. It would be well to take note that 6 volt dry cells described above often are sold with the negative (-) terminal in the center instead of the positive (+) terminal. Beware! Observe the markings carefully on your batteries.

SENSITIVITY: In the words of NASWA’s resident technical analyst, Al R. Niblack, a good receiver will detect most any signal that is present on your antenna. Such is the case with the SX—190. The SX-l90 will detect and amplify any signals that are present on your antenna. Do not be alarmed if your new SX—l90 does not immediately "draw in" all the rare and exotic DX you have been missing before on your portable or other receiver. Propagational conditions change quickly and often. Give your receiver a chance over several weeks.

REJECTION: This is the first quality of the SX—190 I would have improved, although I was not dissatisfied with the rejection qualities of the SX—190. The dual—conversion circuit and filter systems do a first-rate job of rejecting images. However, I have found that the receiver IF gain (inward ring on the volume control) must be backed off about 1/2 when DXing on the 31 and 49 meter bands, or extraneous noises will be generated due to overload of the preselector....... particularly so at the extreme high end of these bands.

OBSERVATIONS: The SX—190 is undoubtedly one of the prettiest machines ever devised. There are several minor annoyances or improvements, which the author has noted, and perhaps SX—190 owners might use their own ingenuity to make needed changes.

The opaque plastic window should have been made from clear plastic in order to facilitate easier reading of the dials in daylight. In this regard, I would also have installed an external light switch to turn off electric dial bulbs to conserve battery power. The dial markings themselves should have been made with white paint on the outer surface of the dial for visibility through a clear plastic window — instead of the present opaque technique requiring light bulbs shining from behind.

The main tuning knob markings do not coincide precisely with the markings in the lighted window. For instance, at the center of the tuning range (250 kHz), the extreme either end may be off 3-4 kHz. This is a minor point and quite easily corrected by the built—in calibrators and shifting of the dial—clutch assembly. (Some persons actually have not read their instruction manuals closely enough and are not aware that the knob handle and markings disc are slip—clutch connected) Still, if the window calibration really bugs you, it may be more closely corrected by taking the top off the receiver, front toward you. Looking straight down from the top you will see in the center of the receiver a screwed down metal plate with holes in it. This is the VFO section. I will NOT attempt to guide you in the proper steps to do this - there is too great a risk that something will go wrong and I might be blamed. I will only advise you that a plastic slug tuning tool to fit T—7 and a plastic screwdriver to fit TC—14 will adjust those two devices. One of them contracts and expands the tuning range width, and the other adjusts the entire range up or down. Between judicious and balanced adjustments of the two, a satisfactory match with the dial markings can be achieved - though it will not be perfect. CAUTION: See a qualified technician to do this for you. Amateur attempts to do this invariably results in costly realignment jobs.

The SX—190 is too inconveniently dismantled for replacing crystals. There needs to be a lift up door on the top of the receiver rather than having to fool around with a bunch of little screws, which are easily lost. This would permit easy substitution of crystals - particularly so when simply interchanging the 60 and 75 meter crystals.

The SX—190 needs to have its circuitry reworked to permit crystal addition or substitution without need for change in capacitance.... this is a major stumbling block for the serious DXer who desires to add various crystals for out—of—band DX.

Unless the reader buys PL—259 plugs for attaching his antenna lead in, this may be somewhat of a perplexing chore. The author uses three different coaxial cable lead—ins coming from backyard antennas. These lead—ins are RG59/U cable. I have bared the center wire of these by removing the outer covering and wire mesh from around the center plastic covered wire. Then I carefully bare about 1/4" of the center wire, bend it back against itself, and it pushes very neatly and snuggly into the antenna socket hole.

SOME SIDE SHOT TRICKS: Your preselector may be deliberately mis—tuned to provide some out—of—band frequencies. This is very nice for those of you who do a bit of dabbling in utilities. It is achieved thus: Tune the preselector up 5,840 kHz (2 x 2,920, the upper IF at zero) above the frequency band you are switched to. For instance, your present 3.5 MHz (75 meter band) position may be mis—tuned by tuning the preselector up to around 9 MHz (actually, it is 3,500 plus 5,540 kHz=9,340 kHz). Your zero "0" on the main knob should now be about 9,340 kHz. Get the highest reading from your S—meter. The dial then descends 500 kHz in frequency to 8,840 kHz at 500 on your dial. Note that KOL Israel is then found at approximately 330 on your dial, which is really 9,009 kHz. Other crystals will produce similar out—of—band ranges — except some low range crystals (9.5 and 7), which are, too near the top of the low range to add 5,840 kHz and still stay within limits of your preselectors low range (3.0 to 10 MHz). A chart of potential ranges is provided:

MIS—TUNE CHART I & II

Crystal	0	100	200	300	400	500
3.0*	8.84	8.74	8.64	8.54	8.44	8.34
3.5	9.34	9.24	9.14	9.04	8.94	8.84
4.6*	10.44	10.34	10.24	10.14	10.04	9.94
5.7	11.54	11.44	11.34	11.24	11.14	11.04

Another method to mis—tune calls is to put various low range crystals into one of the high range sockets - preferably the useless 14 MHz socket. This produces additional out—of—band ranges, but this time in increasing frequency order from 0 to 500. Also, you must mis—tune on the high half of your preselector. A chart follows:

Crystal	0	100	200	300	400	500
3.0* CHU	14.70	14.80	14.90	WWV 15.00	15.10	15.20
3.5	16.20	16.30	16.40	16.50	16.60	16.70
4.6*	19.54	19.64	19.74	19.84	19.94	WWV 20.04
5.7	22.80	22.90	23.00	23.10	23.20	23.30

The theory for coverage by this second method is 3 x crystal frequency, minus the 1st IF frequency to which your dial is tuned (2,920 at zero). Indicates crystals bought from International. Also, most of you have already discovered that your dial covers a few extra kHz below zero and above 500.

EXHALTED CARRIER DETECTION

To aid in determining exact frequency or whether a weak station is even really there or not, the side band BFO may be used to pin point carrier Waves. First, calibrate your receiver with the nearest 25 kHz markers from your suspected catch. Use the "Select" mode of your q—multiplier to enhance sharp tune. Next put your mode switch on Upper side Band (USB) and, while your 25 kHz marker is still ON, turn your main dial slowly toward the USB mark in the window (about 1.5 kHz) until the descending tone disappears. This should be nearly exactly on the USB mark. If not, make it so by adjust your dial wheel. Now your dial is accurate. Turn off your calibrator; reset your mode switch to AM; tune in your suspected catch. Now, once again reset mode switch to USE and note the heterodyne tone. Tune dial toward the USB mark on the window. When it disappears, note the frequency where the USB mark intersects the dial wheel. These carrier heterodynes are audible on sideband long before you: can actually hear them audibly with your ears on AM, so this method is a good way to see if there is really even anyone there, or how many, for there will be a separate and distinct heterodyne tone for each station.

The author will be happy to have comments about his analysis, or your opinions of the SX—l90. Write Edward SHAW, 621 Burleigh Avenue, Norfolk, Virginia 23505, USA.

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Improve the AX-190 Receiver

From 1970 to late 1971, the Allied Radio Shack Co. had a very nice little receiver on the market. The AX-190, as it was called, was a very respectable ham band receiver; it was priced fairly reasonably, too. Possibly you have one of these gems floating around the shack. Maybe you have the SX-190, the SWL cousin, designed for the shortwave broadcast bands. Both of these receivers are pretty much the same except for their hfo crystals. Performance-wise, the AX-190 series receiver is a cut above the average SWL or Novice receiver. It has a crystal high frequency oscillator, a very stable linear vfo, and two mechanical filters, which give it excellent adjacent channel rejection. Add to this a visual dial accuracy of 1 kHz, along with a 100 kHz and 25 kHz crystal calibrator, and you have a receiver that comes very close to the better ham band receivers that are currently available.

The weak spot of the AX.190 series receiver is the rf amplifier. The receiver is an excellent performer on the low bands below 10 MHz. The weak spot begins to show up from 20 to 30 MHz. It is here that the lack of gain in the front end shows itself as a lack of background noise. This, then, is the point of my article. We're going to make that AX.190 (or SX-190) of yours into a very sensitive set of ears. So sensitive, in fact, that you'll hear the 15 kHz horizontal oscillator of every TV set in your neighborhood. Now maybe you don't care to hear every TV set near you, but think how nice OSCAR 6 and 7 will come in if the gooney boxes are peaking S-9!

The conversions to the receiver itself are basically simple. They amount to changing but a few parts here and there on the rf printed circuit board. The real improvement comes with the addition of a two stage outboard rf preamp. And best of all, the preamp can be installed right in the receiver itself. This is the best way to go since the external amplifier uses tuned circuits, which already exist in the receiver. Grab your manual and follow along with me. Since we'll be making our changes on the rf circuit board only, use the large circuit diagram provided in the manual, If you don't have a diagram, don't despair. All of the mods can be had with only the information in this article.

The AX-190 has a cascode rf amplifier consisting of Q2 and Q3, two JFETs (junction field effect transistors). Were going to replace them with MOSFETs (metal oxide semiconductor field effect transistors). These replacement transistors are not as expensive as their name implies. They can be purchased in single lots from ads in *73 Magazine* and will cost from $.75 to $1.00 each. The 40673 MOSFETs used are lead-for-lead compatible with the original transistors, except that they have an extra lead. This fourth or extra lead is the control or bias gate. Two tiny holes will have to be drilled in the circuit board to accept the extra lead of each transistor. There is a good reason changing transistors. The original JFETs in the receiver have a listed transconductance rating of 2,000 micro-ohms. The 40673 has rating of 12,000, all else being equal. Without getting too technical, this difference of transconductance simply means that our 40673s have 6 times the possible gain of original transistor. (Wouldn't you say that's a good reason to use them?) Our 40673 also has a much higher input impedance, which make interstage coupling less of problem. Now that you know why, let's discuss how.

With both top and bottom covers removed, stand receiver on its side with the component side of the circuit boards to your left. The board will be the one near the bottom. It can be identified easily by the 12 hfo crystals tucked toward the front panel. Refer to Fig. 1 locate Q2 and Q3 on the board. Carefully remove them by touching a small soldering iron to their foil pads. Once they are removed, clean all their mounting holes and PCB pads with a solder sucker. Now using Fig. 1 as a guide drill two holes with a printed circuit drill, one hole at Q2 and one at Q3.

After drilling, make sure that you haven't pierced any circuit board foil. The transistor leads that will be going through these holes will be hand-wired on the bottom the board. Now slip a 40673 into each position making sure all four leads of each device go through the board. The tab on Q3 should be pointing down and the tab on Q2 pointing to the lower right-hand corner. Solder three leads of each device that have circuit foil under them. *Don't cut off* the fourth leg of each transistor. We want as long as we can get it.

Fig. 2 shows the components that are to be added to each transistor. The point that is referred to on diagram is a tie point for the 9-volt supply bus to the receiver rf amplifier. As you can see, a resistor goes from the post to each bias gate. From there, a 50k Ohm to ground paralleled by a .001mF bypass capacitor. Do not omit this capacitor, as it keeps rf off the bias voltage. When soldering, be especially neat, as solder splashes are hard to find and can cause endless troubles.

Now, referring to Fig. 1 again, locate R2, a 100k-Ohm resistor, and replace it with a 1 rnegohm. This change puts the MOSFET gate at a higher potential above ground. Also locate R6, a 33k Ohm resistor, and replace it with the 33k Ohm you removed in the preceding step. This last change improves the sensitivity of the agc gate transistor. This in turn lets the rf amp run at almost full gain on noise or weak signals. The end result will be a compression effect similar to the compressors used on SSB transceivers. The credit for this last modification belongs to Bruce Mackey.[1] In his article, which appeared in a past issue of *CQ Magazine;* Mr. Mackey describes modifications to the AX-190 agc circuit.

With the MOSFETs installed a noticeable increase in sensitivity will be realized. This will be especially true on 23 MHz, where background noise becomes an index of rf gain. You may wish to stop here.

You have added about 9 dB of gain with the modifications to the rf stage. But if you are as much a purist as I am, you'll want to build up the circuit in Fig. 3. With this little two-stage preamp, you'll add an extra 20-25 dB of gain ahead of whatever gain you already have. With this circuit, your rf gain control will do something instead of just sitting there at full clockwise. A look at Fig. 3 will disclose 2 more 40673s. These devices, like the ones in the receiver, are hooked up in cascode. This means that the first device uses its gate as the input, the normal situation, while the second device runs with its gate at rf ground. In this case, the source becomes the input with rf output taken at the drain. Because the second MOSFET is run the equivalent of common base (grounded grid), the amplifier does not require neutralization.

Construction of the preamp will be more or less up to you. I used a piece of glass perf board about 1 in. x 2 in. If you build the preamp to these dimensions, it will be small enough to fit right in the AX-190 antenna compartment. Just solder a piece of strip copper to the preamp at a right angle to the plane of the board. The copper strip can then be soldered to the receiver tin shield. Tbis method provides a dc ground, but more important, a good rf ground. The dotted line of Fig. 2 will give you an idea of where the preamp board should go.

As mentioned earlier, the preamp has no tuned circuits of its own. Its input and output are tuned by 2 ganged circuits which are actually a part of the receiver preselector. T1 of the preselector becomes the input of the preamp, and T2 the output. We can use this arrangement because T1 is the antenna trim in the receiver and is only a passive stage; it has no active devices. T2 is shared by the preamp output and the receiver rf amplifier input. All we have done is take an empty resonant circuit and give it some gain, about 25 dB worth.

To put the final touches on things, you'll want to peak up all the coils on the rf circuit board. Set the bandswitch to 3.5 MHz and get about a 3 S-unit reading from the calibrator. Peak up T1, T2, and T3 for maximum meter reading. Back off on the rf gain if the S-meter goes above S-7. Now switch to 28.5 MHz with the same procedure and peak up L4, L5, and L6. It might be necessary to repeat both procedures at least one time since the coil banks interact with each other. To make a quick test of the preamp, set the bandswitch to 28.5 MHz (or the highest band on the SX-190). With the rf gain control backed off one-third from maximum, there should still be a few S-units of noise on the meter. With gain turned up full, the meter will be near pinned from background noise. For best listening, set the rf gain until you get a noise level of about 2 or 3 S-units. Don't worry about signals that are too strong, because the alc will do its thing and maintain an audio output that will stay within 6 dB from noise to full quieting.

One final comment is necessary. You may find that at certain frequencies, the preamp will oscillate. Oscillation can be confirmed if you can tune the receiver by moving the preselector. If this is the case, simply detune either T1 or L4 very slightly. If you have trouble between *3.5* MHz and 10 MHz, detune T1. Between 10 MHz and 30 MHz, detune L4 slightly until the oscillation stops and the preselector peaks up normally. That's about it. You now have a much-improved AX-190. The extra gain is really unnecessary most of the time. But, if you chase DX or OSCAR, it will really come in handy. I hope that these modifications will make your AX-190 into a really fine set of ears.

References

1 Improved Age for the Allied Radio Shack 190 Receivers, Mackey, Bruce L. ***CQ Magazine.*** July. 1973, Vol. 29. No. 7. page 55.

2 ***Allied AX.190 Instruction Manual.*** page 20, "Schematic Diagram of rf Amp." Copyright '71 by Allied Radio Shack.

3 ***RCA Top of the Line Replacement Guide.*** Copyright 1968 by Radio Corporation of America.

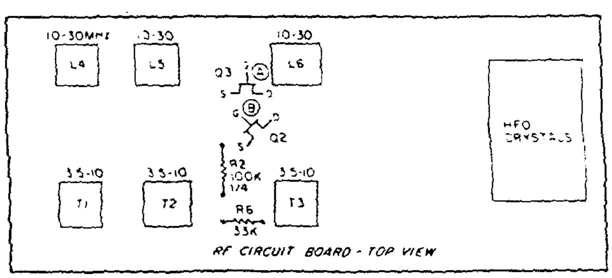


Fig. 1. View of rf circuit board from the top. The A and B marks next to Q2 and Q3 show the spots where the extra holes are to be drilled. Shown also are the locations of R2 and R6.

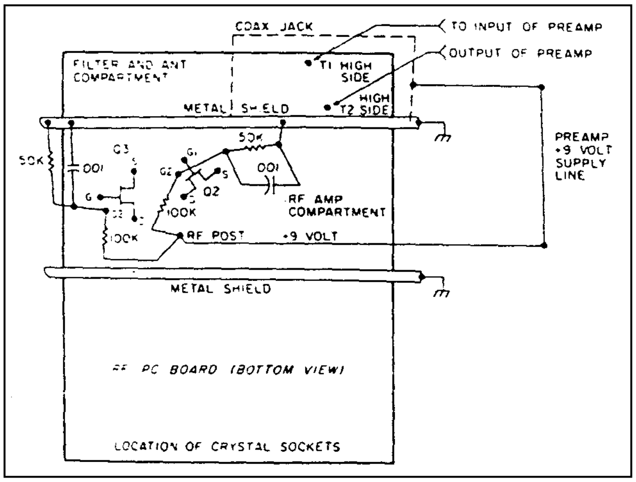
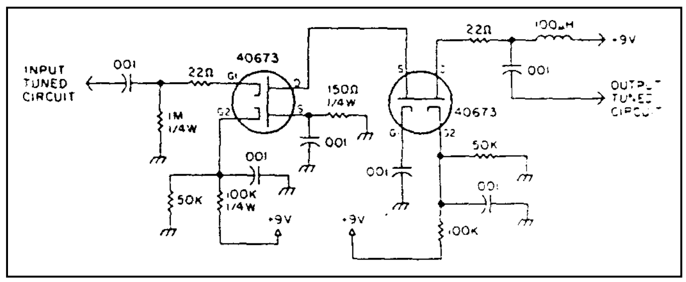


Fig. 2. Rf circuit board, bottom view. On both Q2 and Q3, the G2 connection is the second gate. G2 leads must not touch any circuit board foil. Also shown is the placement of the preamp board with its connections to the main board.

Fig. 3. Preamp circuit. Two RCA MOSFETs provide an extra 20 dB gain when used ahead of the AX-190. Note that input and output's tuned circuits are actually a part of the receiver preselector on the if circuit board. Connections to them are made with No. 18 stranded wire and kept as short as possible



Modifying The Allied Radio Shack Series190 Receivers

BY BRUCE L. MACKEY*

For those who may have purchased the Allied Radio Shack 190 receivers after reading the excellent evaluation of these units by Bill Scherer, W2AEF, in the May 1972 issue of *CQ*, here are some simple modifications, which will resolve most of the difficulties encountered, particularly regarding reception of single sideband signals.

The S meter movement is excessively fast for an accurate determination of signal strength on sideband signals and this can be remedied by placing a 500 mf 6 volt electrolytic across the meter movement. A convenient location for this capacitor is on the underside of the i.f. board with the positive lead tied to tie point #18 and the negative lead soldered to the ground cluster located just about one inch from tie point #18 toward the inside of the board.

The fast release of the a.g.c. on sideband can he cured simply by removing R_{66} (1K) and replacing the resistor with a wire jumper. The release time will now be one second. The attack time will be lengthened slightly, but is still adequately fast for s.s.b. reception.

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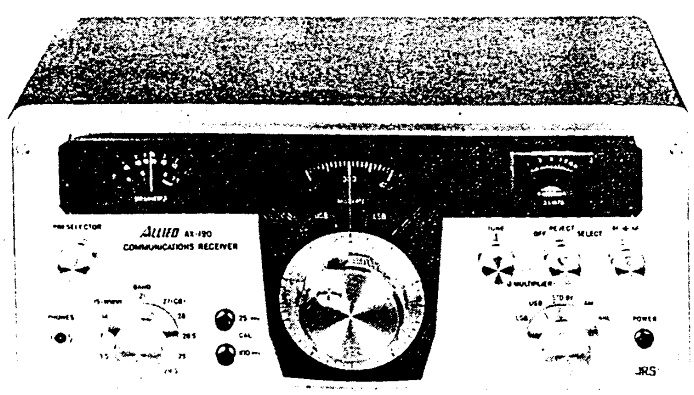
The audio selectivity of the Allied 190 receivers can be improved by removing C_{97} *(350pf)* on the audio board, and the replacement of C_{98} (.00lmf) with .0lmf. This will result in considerably flatter frequency response which begins to roll off at 3 kHz instead of the rising characteristic with which the receiver is supplied. Since C_{98} is the a.c. feedback capacitor for the audio output stage, the hum and distortion of the amplifier will also be reduced by the increase in its value.

To provide a better signal to b.f.o. ratio at the product detector, replace C_{72} (20 pf) with a 4.7 pf. The b.f.o. output transformer should also be retuned as follows: There are two slugs in the b.f.o. output transformer *(T_{12})*. Remove the top slug by backing it out of the top of the coil. There is a slug at the bottom of the transformer which has been screwed all the way clown, (it is not used for tuning in the factory procedure), and this slug should now be brought up toward the top of the transformer. Tune in the crystal calibrator in the u.s.b. mode. As the slug is brought up toward the top of the transform-



The Allied AX-190 communications receiver.

Allied Receivers *[from page 37]*

er, the b.f.o. will stop oscillating. As the slug is brought further up, the b.f.o. will again begin oscillating. Turn the slug up 1 ½ turns from this point. Tuning will be very broad at this point and is not critical. The b.f.o. will now be at maximum output.

To correct for the loss of audio due to the replacement of C_{77} with a lower value, and to correct for poor frequency response in this stage, replace Q_{17} emitter resistor R_{76} (1K) with 100 ohms. The audio level will be restored to its original value and the frequency response on sideband signals will be considerably improved.

It is most important that once the decision has been reached, to make these modifications that *all* modifications be made, as satisfactory results will not be obtained if any of the steps arc eliminated.

Improved AGC For The Allied Radio Shack 190 Receivers

BY BRUCE L. MACKEY*

Our first article in the March 1973 issue dealt largely with improving the Allied Radio Shack 190 series receivers with regard to s.s.b. performance. This one will deal with improving the overall a.g.c. characteristics for all modes of reception. The modifications outlined here in conjunction with those listed in the initial article will produce an a.g.c. curve which will hold the audio output to within 6 db for signal variations of 150 db.

In the a.g.c. circuit itself the following modifications should be made. Replace TH_2, a 10K thermistor with 100K ¼ watt resistor. Replace C_{66} (1 mf) with .01 mf 50 v.d.c. This will increase the sensitivity of the a.g.c. amplifier. To retain S meter calibration change R_{68} 430 ohm to 150 ohm ¼ watt resistor. It is suggested the R_{55} 100 K shunt on the output of the first mechanical filter be removed. While this resistor tends to suppress to some extent the slight tuning peaks which occur on each side of resonance of the filter, it also tends to generally reduce the selectivity of the filter and more important, the sensitivity of the receiver.

The final modification is designed to provide more control in the r.f. stage where control is most valuable. Remove R_5 10K a.g.c. feed resistor and replace with a 1 amp silicon diode. Remove R_6 33K a.g.c. voltage divider and replace with 100K ¼ watt. This combination will result in a more rapid decrease of a.g.c. voltage as applied to the r.f. a.g.c. amplifier with an increasing signal, and consequently greater a.g.c. compression in the first r.f. stage. The logarithmic transfer characteristics of the diode will produce a gain control curve of the front end of the receiver, which will produce a very constant output from the r.f. stage for widely varying signal strengths. It is important that the polarity of the diode be observed, and it should be installed so that the cathode is connected to the base of Q_2, the a.g.c. amplifier transistor for the r.f. stage.

MODIFYING THE SX-190 AND AX-190 BANDSWITCH

John Kolb

The SX-190 is a good receiver in most respects, but it does suffer from a lack of ranges. The purpose of this article is to tell you how to increase the number of ranges below 10 MHz. For each range below 10 MHz you add, you loose a range above 10 MHz. This change is not reversible; once made, it cannot be undone, so you should be certain before you start exactly what you want. The AX-190 is the Ham Band version of the SX–190. The circuitry is similar, but it has even fewer bands below 10 MHz.

First, let's see exactly what the bandswitch is doing. Two of the five switch wafers select the proper crystal for the band selected. The other three wafers, SW1-a, SW1-b, & SW1-c, select one of two possible preselector ranges, 3.5 MHz to 10 MHz, or 10 MHz to 30 MHz. I have followed the practice of calling the low range 3.5-10 MHz to agree with the instruction manual, but Ed Shaw, in the NASWA publication "ALLIED SX-190 RECEIVER A Consumer's Report" reports the preselector section actually tunes down to 3.0 MHz, and a 3.0-3.5 MHz range can be added. Refer to Figure 1 for a partial schematic of the SX-190. The preselector tuning capacitor, VC1, tunes the transformer, T1, from 3.5 to 10 MHz, as the preselector tuning control is turned. This is if the bandswitch is on one of the low frequency bands, and switch SW-1 is open. If the bandswitch is on a high frequency band, SW1 is closed, and coil L4 is in parallel with T1. When T1 is shunted by L4, it's inductance is much lower, and it tunes from 10-30 MHz.

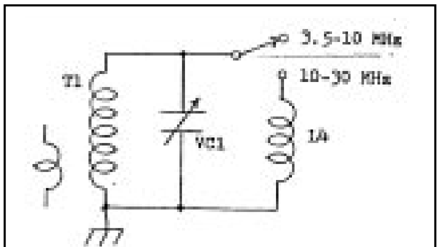
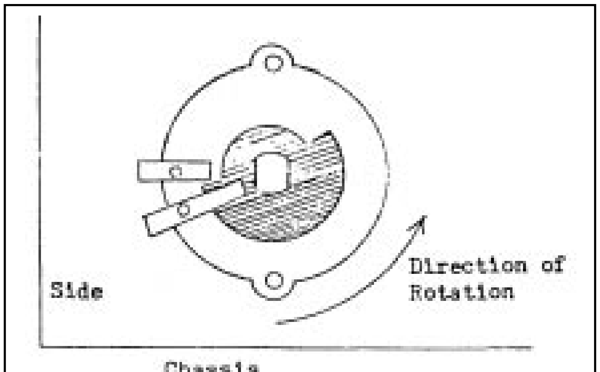
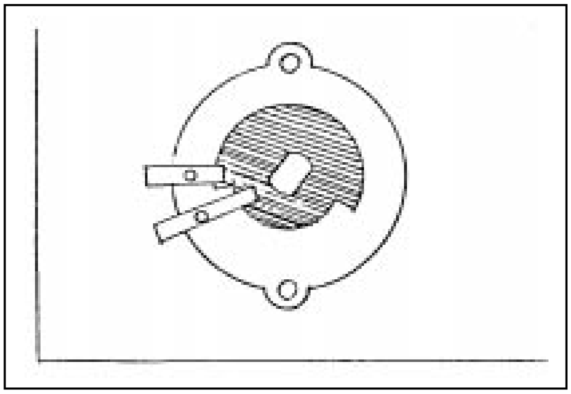


Figure 1.



Preselector low-band, 3.5-10 MHz
Max CCW rotation (Figure 2)


Preselector high-band, 10-30 MHz
(Figure 3)

Refer to Figures 2 and 3 to see how the switch SW1 operates. This is a view of the preselector switch wafers from the rear of the receiver, with the bottom cover removed. Figure 2 is the switch position in the in the low band optional position. This is the maximum counter-clockwise position from the front, as you turn the switch, max, CW as seen from the rear. The lined area is the metal disc, which is the moving arm portion of the switch as shown on the schematic. There are two fixed contacts on the wafer, one long, and one short. The long one always slides on the metal disc, to create a continuous electrical path from one side of the switched circuit to the disc. The short contact makes an electrical connection to the disc only part of the time, when the wide part of the disc overlaps the short contact. When there is an electrical path between the two contacts, as in Figure 3, then L4 is connected to T1, and the preselector tunes from 10-30 MHz.

It now becomes obvious what must be done to increase the number of low band positions. Part of the metal disc must be cut away, so that the two contacts are joined in fewer of the 11 possible switch positions. This is why the change is permanent. Once the disc has been altered, it can't be corrected. The same applies to the actual work; only enough material for the desired change must be removed. The best way I know of is to use a small hobby grinder, such as Roto-tool, with a small, conical grinding wheel. You will cut away part of the disc, as shown in figure 4, depending on how many low bands you want to add. There are three switch wafers to be modified, the three closest to the rear of the receiver. The two front wafers are SW1-d and SW1—e, used for band selection. First decide how many low bands you want to add. If one band, set the bandswitch to 11.5 MHz band: if two, set the bandswitch to 14 MHz. This will give a wafer position similar to figure 3. All the wide area under the contacts is the area to be cutaway. 1lark the disc with a felt tipped pen just above the short contact. This will be the place to stop cutting. Now turn the bandswitch back to the 3.5 MHz band to turn the disc so it's easy to get to the work area. Carefully grind away the required material, remembering at all times that material cannot be added once removed. The disc is flat to pass through the two pieces of the contacts, and must remain so. If it is bent, warped, or has a burred edge, it may deform the contacts, causing a bandswitch failure. Remove all metal filings with a vacuum cleaner, and then spray the discs with a contact cleaner. Remove the crystals for the high bands deleted, and move any crystals required. For example, if it's the 14 MHz band you don't want, then the 11.5 MHz crystal must be moved over one space, and the 11.5 MHz band will now be found where the 14 MHz band used to be. Add the desired low band crystals, and adjust all moved or changed crystal positions per the instructions in the manual. Make new labels for the front panel so that the bandswitch is labeled correctly.

Figure 4.

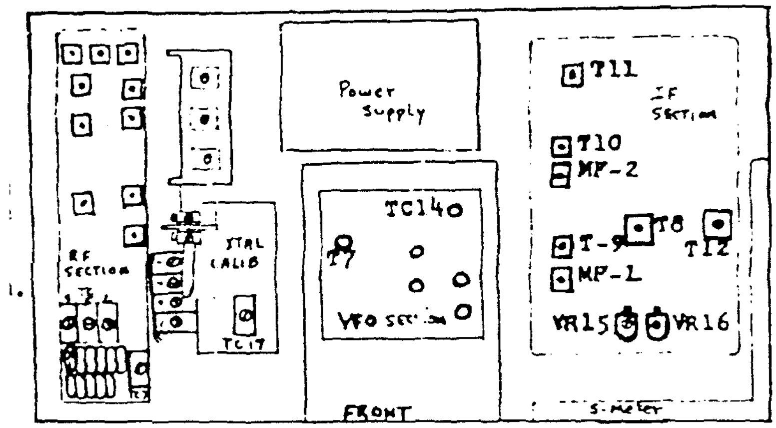
Please make sure you understand this modification thoroughly before beginning, think each step through before taking action, and be careful. Most mistakes in this sort of project cannot be corrected.

ALLIED SX-190 by Ed Shaw

WORK SHOP — Some useful guidance to upgrading of your SX—190 RECEIVER

By far, one of the most popular receivers ever used in the SWL hobby is the Allied SX-190. Despite some of the problems in earlier receivers and the subsequent discontinuation of the model, the SX—l90 still remains one of the best values on the market, although only used receivers can now be found.

This article is intended to aid those owners of SX-l90 receivers with problems they have encountered. Typical of the problems brought to my attention are poor main tuning dial calibration, malfunction of the Q-multiplier controls, and cross-modulation (ghost) signals cropping up in the high ends of the 31m and 49m bands. Here is some advice on these three areas of concern.



For reference, the illustration to the right shows the interior of the SX—l90 with cover removed, front side toward the operator. The far left side is the RF section where extra crystals may be installed. The middle section with the holes is the VFO section. The far right side is the IF section. In this article, we are going to perform some minor tuning adjustments in the VFO section and the IF section. Read carefully.

MAIN DIAL CALIBRATION: This problem can be remedied to some satisfaction, but some special tuning tools will have to be purchased. You will need a set of plastic radio/TV tuning tools, available from Radio Shack or other electronic stores for about $2.00. From this set of tools, we will be using the plastic screwdriver and one of the hexagonal-tipped tools — correct size to be easily apparent when you start. We are concerned with the center VFO section. It has the appearance of a metal box with a screwed—down metal plate on top and having holes in it. Examine the illustration above. Note that the extreme left hole is designated T-7 and the extreme upper—right hole is designated TC-14. The left hole is centered over a ferrite slug—tuned coil which is adjusted with the hexagonal-tipped plastic tool (experiment to find which tip wil1 fit the slug) NOTE, before we go further, it nay be that a pocket size pen flashlight will aid you in seeing into the VFO cover holes in order in order to place your plastic tool correctly. The upper—right hole is centered over a trimmer condenser, which is turned with the plastic screwdriver. Now we are ready to begin. The following instructions are paraphrased from the official SX-190 technical manual, and only minor editing was used for this article.

(1) Receiver should be warmed up 30 minutes before beginning Work.

(2) Connect your antenna.

(3) Control settings: RF gain full clockwise; AF gain adjusted to comfortable volume; Band selector on 15 MHz; Function switch on "AM"; Q—multiplier off.

(4) Tune main dial to receive WWV signal on 15 MHz. Normally it will be at zero on your main dial.

(5) If it is not on zero, adjust the TC-l4 (upper right hole) in the VFO until WWV signal centers on "O".

(6) Remove antenna, no longer needed. Push 100 kHz crystal calibrator button. If S—meter is too far to right, back off RF gain slightly until needle indicates S-6.

(7) Tune main control dial to 400 and search for calibrator signal. If not exactly on 400, adjust the T-7 (left hole) in VFO box until calibrator signal centers on 400.

(8) Tune main control dial back to zero — calibration possibly will be off- center again. Readjust TC-14 until calibrator signal centers on zero.

(9) Repeat step (7), then step (8), then step (7). etc. until the calibrator signal remains centered correctly at the zero and 400 marker spots. NOTE: Remember that the T-7 adjustment is ONLY for the 400 marker spot, and the TC-14 adjustment is ONLY for the zero marker spot. If you confuse the two, erroneous adjustment will result and you will have to start all over again.

SX-190 WORKSHOP PART II by Ed Shaw

Q-MULTIPLIER ALIGNMENT: We are now concerned with two small variable resistors on the right side of your receiver's interior circuit board. These are identical components located immediately behind the S—meter. They appear as two side-by—side semicircles, in the illustration, as VR—15 and VR—16.

(1) Control settings, RF gain full clockwise; AF gain full counter-clockwise; Function switch on "AM"; Calibrator - 100kHz on.

(2) Put Q-multiplier switch to "Reject" position.

(3) Adjust VR—15 (nearest center of the receiver) until minimum reading is obtained on the S-meter.

(4) Put Q-multiplier switch to "Select" position.

(5) Adjust VR-16 until highest S-meter reading is obtained. Readjust R7 gain knob until needle drops to S—3 or S-4.

(6) Leave switch in "Select". Adjust tuning knob left and right to observe whether there is any squeal. If no squeal, Q-multiplier is adjusted. If squeal is noted, readjust VR—16 to slightly less S-meter reading until squeal disappears when tuning knob is twisted left and right.

PART III

CROSS-MODULATION ON 31m AND 49m BANDS (ghost signals)

(1) No work need be performed inside the rece1ver, so cover may be replaced.

(2) Control settings: Band selector for 5.7 MHz; RF gain full counter clockwise; AF gain full clockwise (the is exactly backwards from the recommendation of the Owner's manual)..... we want the RF all the way down and the AF all the way up.

(3) Examine the upper range of the 5.7 MHz (49m band) crystal to observe for ghost cross—modulation signals. Sparing use of the RF gain control used as a volume control will greatly reduce overloading of the preselector and provide better quality reception with less cross-modulation.

(4) This method should be also used on the 31m (9.5 MHz) band. In fact, the method is successfully used on all bands, but in the SX—l90 it seems to be necessary only on the 49m and 3lm bands. The author uses the reverse RF/AF control method at all times.

I hope that the treatment I have described in the foregoing pages will be of use to the SX—190 owners. All questions about the SX—193 are welcome. _I will try to answer all inquires about this receiver and will research a satisfactory reply for you. Simply provide me your question with a self—addressed and stamped envelope. Send to Ed Shaw in care of the SWC address, front page.

THE COMPREHENSIVE SX-190 MANUAL

For Technician Owners

By Ed C. Shaw

I am the first to admit that Radio Shack’s first try was their best... they should have stuck to it. SX—190 and the amateur band sister AX—190 appeared on Radio shack’s shelves rather suddenly as I recall about the summer of ‘71, and at a price of $249.95, including a full complement of crystals covering most of the popular SWBC spectrum or all of the amateur bands. My first purchase was a dog, and the knowledgeable technician they employed devoted a lot of time to study the new schematics and to poke around inside my receiver. As it happened, I ended up with a replacement receiver that had none of the bugs plaguing the first one. It was everything I wanted in a receiver at the time. It still is a mighty contender as an advanced DX tool.

SX—190 was the first SWL Dxing receiver, which was a serious attempt to provide a meaningful tool with first—class features. It was sold with crystals providing coverage of the 75, 49, 41, 31, 25, 20, 19, 16, and 11-meter bands. Options were left blank for the owner to install his own choices for two additional bands. Most NASWA owners opted for the 60 meter and 13 meter bands. Others found innovative ways to install external crystal sockets which then afforded convenient methods of switching crystals for yet further coverage. In reality, the SX-190 could cover frequencies down to 3.0 MHz, the 90-meter band, although they only claimed down to 3.5 MHz.

A large, weighted main tuning knob was graduated in 1 KHz notches, with even finer 200 cycle divisions around the edge. SX-190 boated a crystal calibrator with two different signals, a Q—multiplier and notch—filter, upper and lower sideband — also crystal controlled, and several useful output jacks on the rear panel skirt. The VFO was also rock steady, and frequency did not drift one cycle off, unlike much of the modern stuff which wows and whines whenever you put a hand near the cabinet.

Yes, SX—l90 worked well... for most. Some few had problems like my first one. Many others also did and continue to have a minor overload problem, but only on the 31-meter band. The reasons had mainly to do with the RF coils, which will be explained later. But, to have made it better would have sacrificed the lower frequency range, or the design would have had to be re—engineered for three overlapping ranges instead of two. In any case, the 31-meter band overload problem was usually offset through use of a higher—impedance or shorter antenna wire fed through a tuner.

Their receivers should be selling used for about $150.00 if the receiver is in mint condition. If you can find one for $100.00, jump on it, since you will have acquired an exceptionally fine DX tool, which will delight you and provide endless enjoyment. In my opinion, the SX-190 is vastly superior to any receiver on the present 1982 market for $500.00 or less. EVEN CONSIDERING that SX-190 is not digital and only provides segmented coverage by crystals.

In the pages that follow, I have attempted to provide as much experience as is practical to enable the SX—l90 owner to modify his SX—190 if desired. Or merely to keep it tuned in optimum condition, some modifications I describe are quite extensive as they alter the basic design of the original SX—190, and when such modifications are successfully completed, the owner essentially has a different receiver. So...on to the SUPER-X 190!

A LIST OF OBSERVATIONS AND MODIFICATIONS

I. To Install Additional Crystal Coverage

II. Ta Change Crystal Calibrator To 5 KHz Verses 25 KHz

III. To Change AGC Response Time - Or Adding-On A Switchable Option

IV. To Defeat AGC For Inverted Gain Control Technique

V. Adding-On An Externa1 Switch For Dial Lights To Conserve Batteries

VI. Adding-On An Internal Speaker

VII. Replacing Cabinet Screws With Quality Hardware

VIII. Installation Of A Crystal To Provide DSB For Exhalted Carrier DXing

IX. To Increase I.F. Gain - Sacrifices Some Selectivity

X. Remedy For Inaccurate S-Meter, Or To Make Meter More Sensitive.

XI. Increasing Gain Using A Bridge Rectifier As A Detector

XII. A Transistor Substitution Guide

XIII. Remedy For 31-Meter Overload

XIV. Transposing Crystal Positions From Lower To Upper Range and Reverse (Relieves 31-meter overload, provides additional low-range option)

XV. Tuning Out-Of-Band Ranges By VFO Harmonic Technique

XVI. Adjustment Of VFO To Bring Dial Into Good Alignment 0-500

XVII. Adjustment Of RF Stages For Peak Reception

XVIII. Adjustment Of 455 KHz LF. (Only If Necessary)

XIX. Adjustment Of Q-Multiplier And Notch Filter

XX. Re-drilling Face Plate For More Convenient Removal

XXI. Adding A Tone Control For Audio Output

XXII. ______________________________

XXIII ______________________________

XXIV. ______________________________

XXV. ______________________________

NOTE: On pages with schematic illustrations, arrows depict the areas relating to these modifications and are identified by roman numeral.

I. TO INSTALL ADDITIONAL CRYSTAL COVERAGE

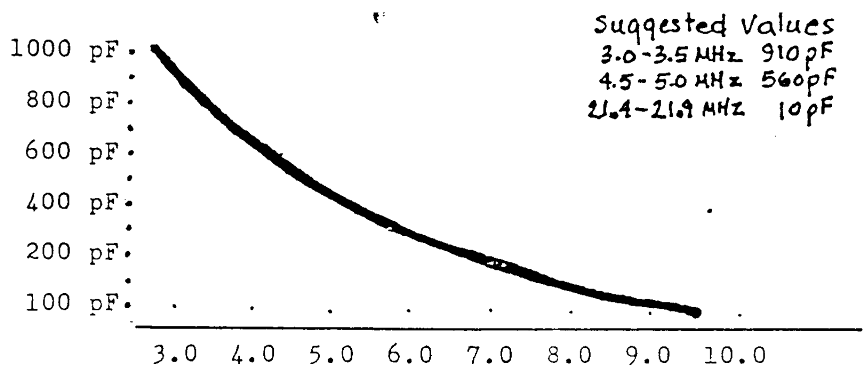
The owner invariably will want to fill up blank options with the most popular bands available. There seems to be no better choices than the 60-meter and 13-meter bands. Other choices, however, include the 90-meter or 11-meter bands or perhaps the amateur 20-meter or 15-meter bands. Specialized coverage can also be ordered as well in any 500 KHz segment. Utility Dxers may enjoy adding a crystal to cover 8300-8800 KHz. Farsighted DXers may want to have the projected new 21-meter band crystal for providing 13.5 to 14.0 MHz for future SWEC.

In any case, the criteria for ordering crystals is as follows:

a. Decide what 500 KHz segment is desired (i.e. 4500 to 5000 KHz)

b. Add 2920 KHz to the low-end frequency (4500 KHz). In this case we end up with 7420 KHz, the crystal frequency needed

c. Determine the parallel capacitance needed for the crystal:



d. When ordering crystals, specify type HC-25/U, .005% tolerance or better.

Therefore, in our example we need an HC-25/U crystal, .005% tolerance crystal frequency of 7420 KHz, parallel capacitance of 560 pF. In order to avoid possible confusion, crystal manufacturers often ask additional questions about your receiver, such as what frequency coverage you want the new crystal to provide, what is your VFO frequency range, or what is the crystal formula, etc. You should only be alert to avoid confusing yourself over terms. "Crystal Frequency" and "Frequency Coverage" (or some similar wording) are two different things. Always be certain that you understand that the term "Crystal Frequency" (in our case) means _______ KHz + 2920 KHz. The manufacturer already understands this. SX-190 crystals will always have to be made 2920 KHz higher than the lowest we really want to hear. In case you are asked, your crystals are fundamental.

Source: Jan Crystals, Inc., 2400 Crystal Drive, Box. 06017, Fort Myers, Florida 33906. To be safe, write first for their informative catalog. Usually, their first pages cover fundamental crystals of the type and size we desire.

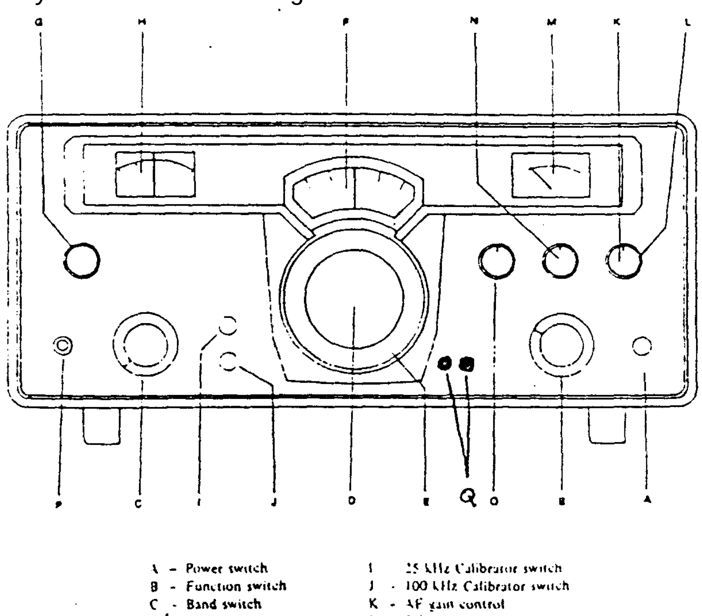
Standard Capacitor Values. In case you did not realize it, and for your convenience, I have listed here some standard capacitor values which may be used, and which should be a little less expensive than "in-between" values.

Choose from this list the value, which most nearly fits your crystal requirements. Be prepared to substitute one higher or lower in value if the first try doesn't work. Values shown are in standard picofarads (pF) 100, 120, 180, 220, 330, 390, 470, 560, 680, 820, 910, and 1000 pF. Such capacitors should cost no more than pocket change.

Installation. With the case top off and receiver front toward you, find the crystal sockets at front left. Note that the first and last sockets are unfilled. The first socket is for one optional crystal between 3.0 and 10.0 MHz. The last socket is one option for 10.0 to 30.0 MHz.

Merely plug your new crystals into the appropriate socket and turn the receiver over with the case bottom removed to expose the underside guts.
The area we are interested in should now be on the right, front toward you. Observe that the band selector switch has several wafer attached; the two closest to the front are the ones we are interested in. By close examination, you will observe that each crystal position has a capacitor connected from the tabs of the wafer to a nearby ground lug. Note that the blank LOW option has no such capacitor. You must install the capacitor you have chosen, following the example of the others already installed. It will help perhaps to note the center wiper tab of each wafer and how it makes contact from crystal to crystal. The upper blank option needs no capacitor if you choose a crystal above 21 MHz. Higher frequencies require very little capacitance to make the crystal oscillate.

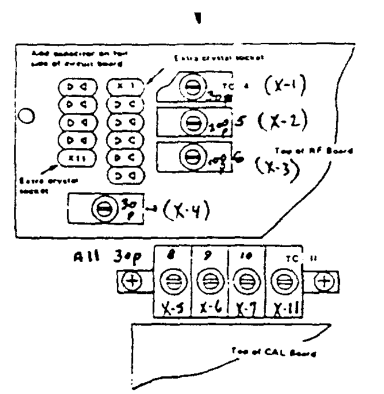
Most of the low range and high range positions have a trimmer capacitor with which to make minor adjustment so that your new crystal will oscillate "right on" frequency. For instance, if your new crystal is for 4.5 to 5.0, you may tune up WWV on 5.0 MHz. That is 500 on the dial now. If it is not exactly right on frequency, you may "trim" the appropriate capacitor to get as close as you can. See diagram below.



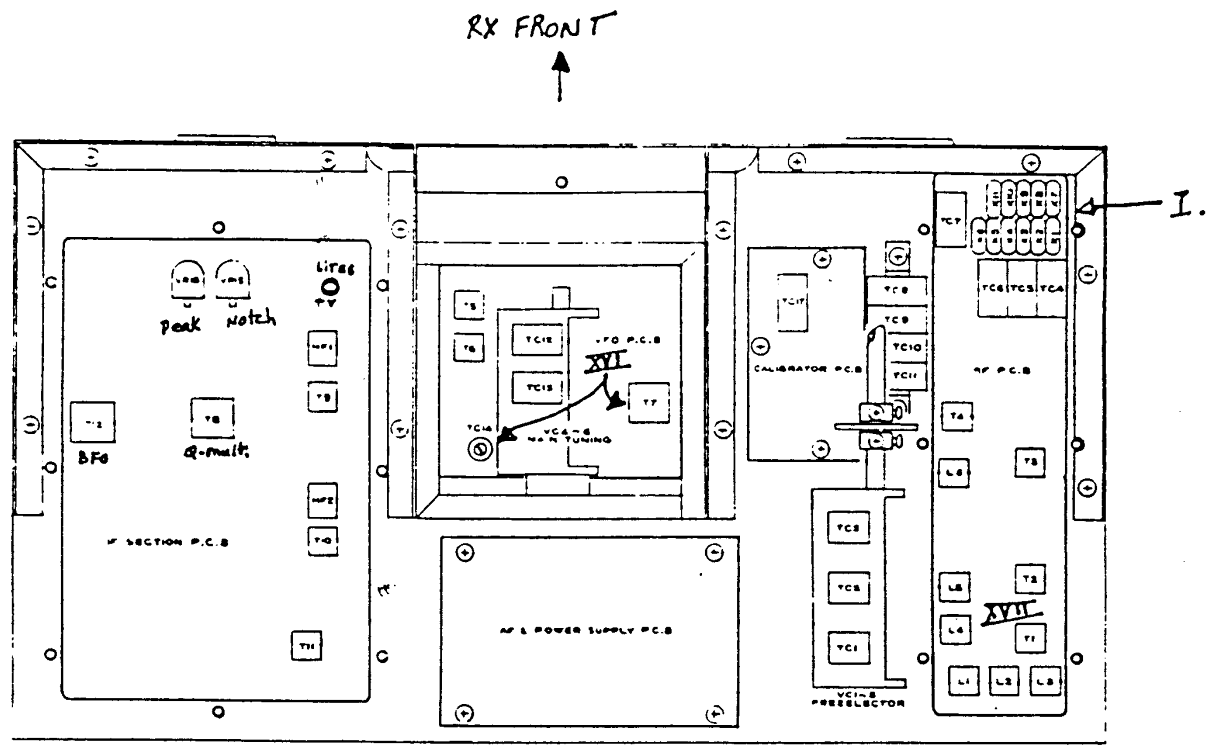
A – Power switch
B – Function switch
C – Band switch
D – Main tuning knob
E – Dial skirt
F – Main dial
G – Preselector
H – Preselector dial
I – 25 kHz Calibrator switch
J – 100 kHz Calibrator switch
K – AF gain control
L – RF gain control
M – "S" meter
N – Q-multiplier switch
O – Rejection tuning
P – Phones jack

Q – New Light Switchs, etc.

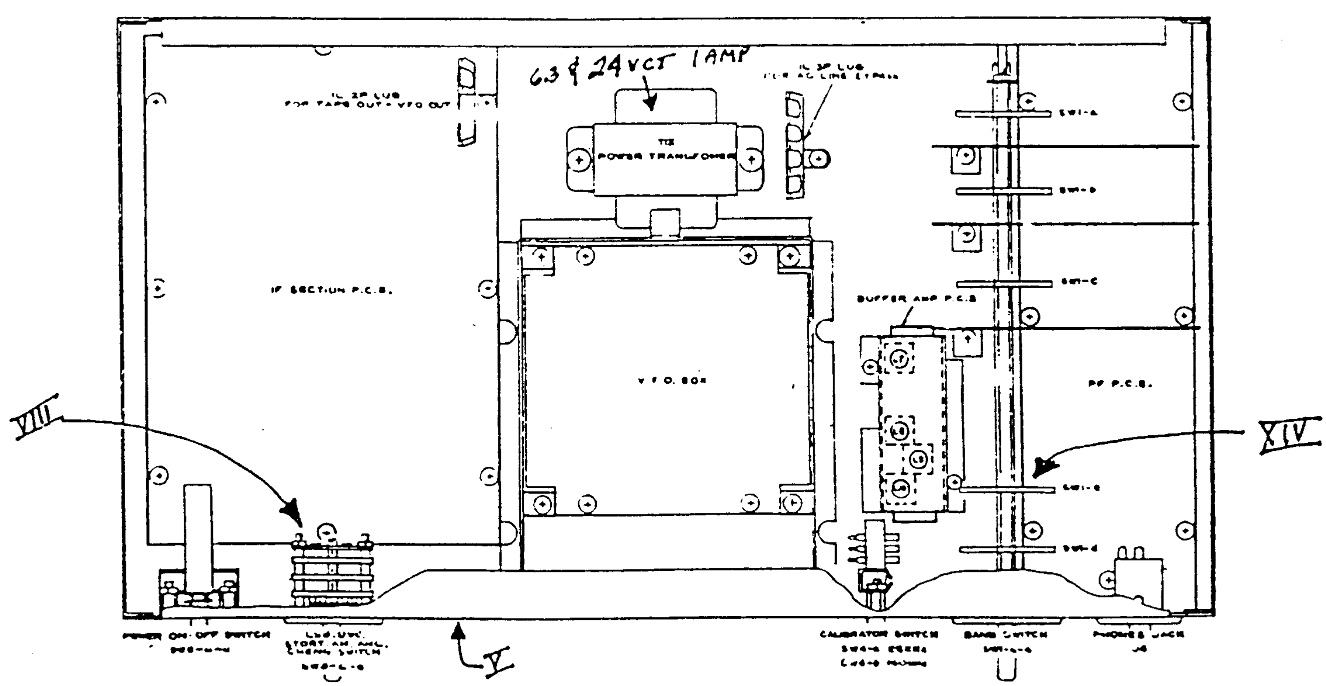
(4)



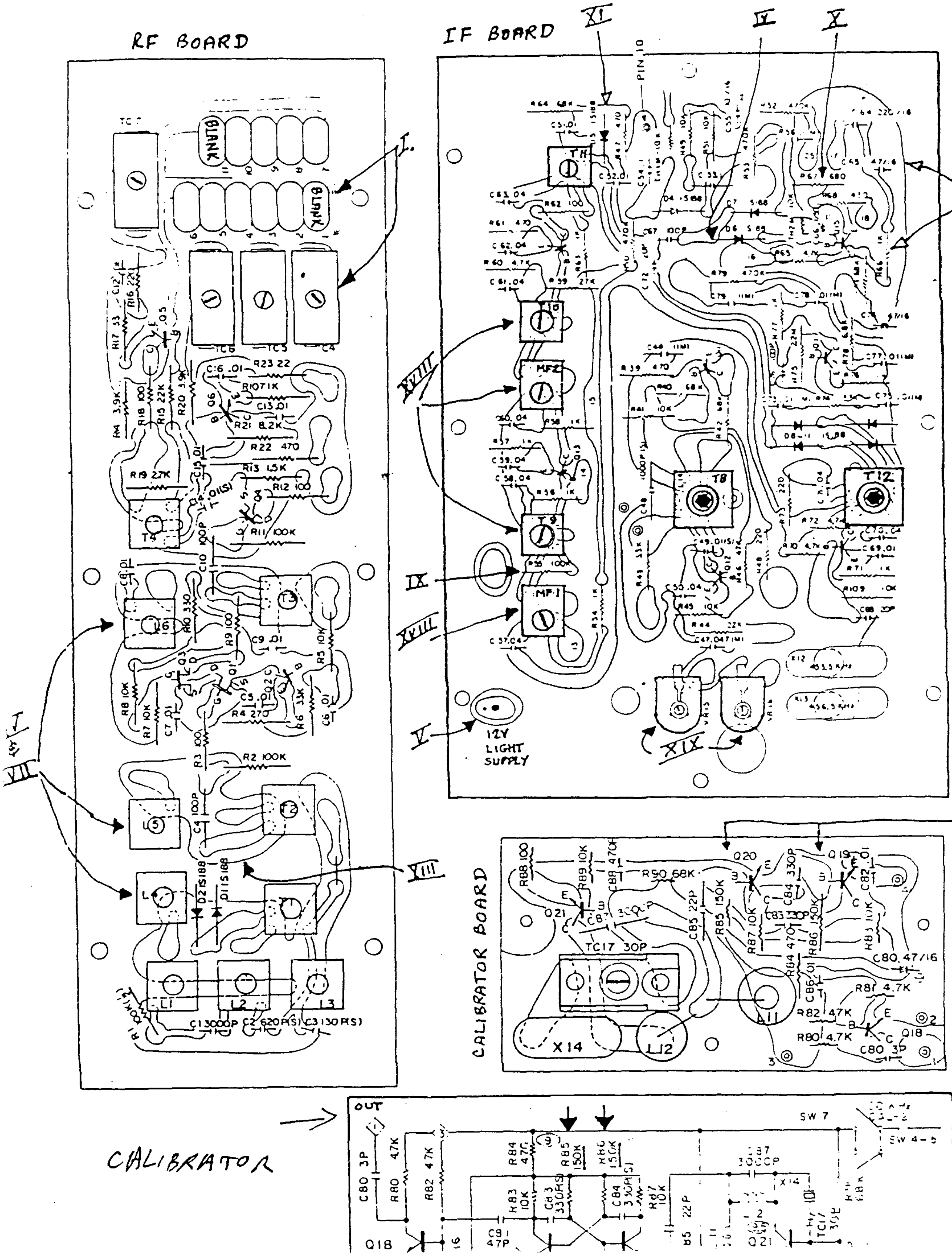
Note: Crystal positions Nos. X-8, X-9, X-10 have no TC trimmer capacitor. Trimmer values shown penned in.



Top View



Bottom View


RF BOARD
IF BOARD
CALIBRATOR BOARD
CALIBRATOR
12V LIGHT SUPPLY
PIN 10
OUT

II. TO CHANGE CRYSTAL CALIBRATOR TO 5 KHz VERSES 25 KHz

The crystal calibrator employs a fixed crystal of 100 KHz in a simp1e oscillator to provide the 100 KHz markers, which is injected into the RF stage for us to hear. By pushing the 25 KHz marker button, a flip-flop circuit is activated to divide the 100 KHz by 4... or 25 KHz. We can change the time constant resistors to divide the 100 KHz into anything we want.

On page (6) find the calibrator drawings and locate the two resistors, R35 and R86. They are 150K values. These may be and replaced by a pair of the following resistors, which will produce different signals.

Pair of resistors, R35 and R86...	Should produce markers at...
1.0 Meg	5 KHz
500 K Ohm	10 KHz
150 K Ohm	25 KHz
75 K Ohm	50 KHz

Note: Be prepared to increase or decrease the actual values of resistors used. The above are given only as a general guide. Since all circuits may not be precisely equal in harmonic balance, values may have to be varied somewhat, but the concept is sound. You will also note that values "in-between" will produce signals for dividing 100 KHz at odd places...i.e. 220,000 (220K) Ohm resistors may produce a division by 6, resulting in markers for every 16.666 KHz. Of course, this is a useless marker for our purpose. Ensure that the resistors you try are producing the signal you want before reassembling the receiver case.

III. TO CHANGE AGC RESPONSE TIME - OR ADDING-ON A SWITCHABLE 0PTION

On page (6) locate resistor R66, a 1K value. You may snip and lift one end of this resistor off the board (leave the other end intact) if you desire to increase the AGC response time to approximately 5 times. Since normal response time in AM is approximately 100 milliseconds, the time should increase to approximately 500 milliseconds. This method affects both AM and SSB modes.

To provide a longer response time in AM mode only, you may replace the capacitor C65, a 47uF value with something larger in value. Twice the value (100uF) produces twice the response time, etc. However, in doing this you will have to replace the SSB response capacitor C64 because this modification will also further delay the response time for SSB unless you reduce C64 to compensate.

The best option, which suited the author perfectly, was merely to install a jumper wire on switch no. 3, wafer (a) between tabs 2 and 4. This puts the AM response time at approximately 500 milliseconds, same as for SSB.

In addition, I might have decided to install a small toggle switch out thru the front surface of the receiver whereby I could switch the jump wire in or out to provide FAST or SLOW AGC response time. A single—pole, double-throw type is needed for this.

IV. TO DEFEAT AGC FOR INVERTED GAIN CONTROL TECHNIQUES

Many DXers don't even know about inverted gain control technique. This merely allows the operator to turn up the AF gain full and use the RF gain to control volume. Many receivers will do this which have provision for manual gain control. SX-190 has automatic gain control (AGC) with no provision to disable it, so we must install out own.

On the IF board (page 6) locate AGC detector D6. Note that the cathode end shares a land with one leg of a smallish green thermistor. To defeat AGC we lift one side of the diode to prevent any voltage from the detector area from reaching the AGC. Install an external toggle switch to enable you to switch in or out the diode we have just lifted.

Note: In the lifted (no AGC) position, the meter is also defeated and you will have no deflection on it.

<u>How to use this technique.</u> Defeat the AGC. Turn RF all the way down. Turn AF gain all the way up. Increase RF gain just enough to hear signals. Tune in a weak catch...center it carefully. Ensure the Q-multiplier is engaged in the Select mode. You should note that the Q-multiplier is very markedly increased in selectivity, with side interference greatly reduced due to AGC being defeated. Our modification raises and narrows the Mu factor of the Q-Multiplier.

V. ADDING-ON AN EXTERNAL SWITCH FOR DIAL LIGHTS TO CONSERVE BATTERIES

A very simple modification. Observe the inside of your receiver and see how all the bulbs are gathered together by their leads... one leg to ground and the other leg to a 12V source pin on the IF board. Underneath the IF board you will find one gray and white striped wire affixed to the same pin which provides the power. Unwind the wire from around the pin and install a small toggle switch between the wire and the pin. The toggle might be installed thru the front panel, or thru the rear panel. See the section on installing auxiliary switch holes in the front panel.

VI. ADDING-ON AN INTERNAL SPEAKER.

Another simple modification. Obtain a 2x3 inch oval speaker. They are available as common cassette recorder replacements. Something larger could be used if you want to put it in the top surface of your receiver. I preferred the smaller speaker installed out thru the side of the top case.

Remove the receiver top case. Working from the inside surface of the case, situated the oval speaker so that it will be affixed on the left side of the receiver toward the rear. Carefully draw around the speaker shape with a pencil, carefully annotating where screws should hold the speaker. Put the speaker aside and carefully continue to draw a near-perfect oval (same size as speaker cone). You will have to trust to your artistic ability to draw a good oval, centering it correctly among the screw holes, etc.

Next, draw several horizontal lines with a ruler lengthwise thru the oval, and also vertical lines - all seated about 1/4 inch. The hatch pattern you have drawn will provide points where you now drill 1/8" holes all within the oval area to permit sound to pass thru the cover. Don’t forget to also drill holes for the screw holes for mounting the speaker.

Underneath the chassis, examine the speaker jack (J7) on the rear panel. You will find three contacts. One goes to ground (chassis), one goes to the headphone jack, and the other has no wire attached. It is here and also to the ground pin that you should attach a pair of wires which will go to your new speaker.

You may want to further devise someway to plug and unplug the internal speaker wires for ease at removing the top cover. Otherwise, the top will always be tethered to the receiver by the speaker wire.

Using the correct connections described here, the new internal speaker will disconnect whenever headphones are plugged in or whenever an external speaker is plugged in.

VII. REPLACING CABINET SCREWS WITH QUALITY HARDWARE

While not exactly a modification, the owner will soon become aware that the inexpensive (and metric) Philips head screws holding his receiver cabinet together become easily stripped, scratched on their anodized surfaces and generally become unsightly and damaged.

Buy or borrow a tapping tool to enlarge all screws to #6-32 size, and then purchase either hex-head screws to match or other fancy head screws of your choice. In any case, ensure the new screws are first quality steel products, which will not strip. The author used a product called "binder head" screws. They are large, but flat headed screws presenting an attractive appearance while still serving their purpose.

VIII. INSTALLATION 0F A CRYSTAL TO PROVIDE DOUBLE SIDE BAND

This is a moderately tedious job; therefore inspect all aspects of the job before you tackle it. Follow the leads through from beginning to end so that you are familiar with where they go and what they do.

First, you must acquire a 455 KHz crystal (See bottom of page 3). Next, locate switch SW-3 in the drawings on page (5). Note that the switch has three wafers, each with two hemisphere sections. Two and one-half wafers (five sections) are used. On section D, remove yellow wire (which came from noise limiter diode) and leave it hanging free in case you want to replace it someday. On section B, install one leg of 455 KHz crystal to pin 5, other leg to nearest ground. Use short pieces of wire to assist if crystal is the type having no long wire leads. On sections A, C, and D, add jump wire from pin 2 to pin 5. You have removed the ANL and subbed in its place a 455 KHz BFO that zero-beats right on a signal carrier, unlike SSB crystals, which zero beat 1.5 KHz to either side of the carrier. This technique lets you zero in on a catch precisely, or calibrator signal.

IX. INCREASE I.F. GAIN, SACRIFICES SOME SELECTIVITY

Examine the I.F. board drawing on page (6) and locate R55, a 100K bypass resistor. Snip and lift one end of the resistor. Doing this widens slightly the selectivity skirt of the I.F., but provides about 3 dB extra gain. This is a modification which I normally would not recommend unless you need all the signal voltage you can get for DXing consistently weak catches having not much interference close by.

X. REMEDY FOR INNACCURATE S-METER

On the I.F. board drawing of page (6) locate R67, a 680 Ohm resistor which is parallel to the meter and R68 series resistor. While the receiver is off, remove B67 and replace it with a stand-up type adjustable resistor, which can be adjusted between about 200 to 1000 Ohms. Such a variable resistor costs about 75 cents or less. There is no easy way I can suggest how to adjust the meter for best accuracy short of employing professional equipment. As a rule of thumb, you may push in the 100 KHz marker button and center your dial on an appropriate 100 and then adjust the resistor so that the meter needle centers right onto the 40 dB over S-9 mark. (Ensure your prese1ector is peaked and the Q-multiplier is OFF.

If, for some reason, you desire to increase the sensitivity of your meter, adjust the variable resistor up to maximum 1000 Ohms, thereby directing most of the signal thru the meter. If more sensitivity yet is required (and I can’t imagine why), merely remove R67 and jump a wire across R68. This leaves the meter alone in the emitter circuit of Q-15. It sure will jump now at the slightest weak catch. In fact, it will bang with a slight "ping" sound as the needle smacks the right-side restraint post inside the meter - at stronger catches. Not a good idea.

XI. INCREASING GAIN USING A BRIDGE RECTIFIER AS A DETECTOR.

Caution: Obtain Matched Diodes Only

In the main schematic and on the I.F. board drawing Page (6), locate detector diode D-5, a glass germanium diode of the lN34 type. Nearby is also 1ocated T—ll. This is a tricky modification involving intricate workmanship and attentiveness.

First, locate the two lands, which are the ends of the smaller secondary winding of T-11. One end will be to ground; the other will be to the detector diodes cathode end. You must cut a channel across these two lands, isolating the two ends of the secondary. Next, find the 100pF capacitor C67 and lift the leg, which is connected to the detector cathode end. All of this work is very close together I admit.

Prepare a bridge of detector diodes using four 1N34A diodes. Affix the two AC input ends to the two secondary lands we isolated in T-11. Next, jump a short wire from the lifted leg of C67 to the upper T-11 secondary (formerly going to D5) D5 should have been removed by now. The (+) positive output of the bridge should be affixed also to the lifted leg of C67. The (-) negative of the bridge should be affixed to the anode land where old D5 was removed. R64 also touches there, to aid in locating.

Essentially, all you have done is to isolate the T-11 secondary ground leg, applying both T-11 secondary legs to the new bridge. The outputs of the bridge fit where D5 was removed. You now achieve full-wave detection resulting in a cleaner and stronger I.F. signal.

XII. A TRANSISTOR SUBSTITUTION GUIDE

Device #		GE sub	ECG sub	Function
Q1	2SK19	FET-2	459	Cascade RF Stage
Q2	2SC373	212	85	AGC Amp.
Q3	25K19	FET-2	459	Cascade RF Stage
Q4	2SK19	FET-2	459	1st Mixer
Q5	2SC371	61	289A	1st Local Osc.
Q6	2SCS71	61	289A	1st Local Osc. Emitter Follower
Q7	2SC372	61	85	1st IF Band Pass Amp.
Q8	2SC784	60	229	2nd Mixer
Q9	2SK19	FET-2	459	Variable Frequency Osc.
Q1O	2SC372	61	85	Variable Frequency Osc.
Q11	2SC372	61	85	"Q" Multiplier inverter
Q12	2SC372	61	85	"Q" Multiplier
QJ3	2SC372	61	85	2nd IFAmp.
Q14	2SC372	61	85	2nd IFAmp.
Q15	2SC373	212	85	AGC Amp.
Q16	2SC372	61	85	BFO
Q17	2SC373	212	85	AFAmp.
Ql8	2SC373	212	85	CAL. Buffer Amp.
Q19	2SC373	212	85	25KHz Multi-vibrator
Q20	2SC373	212	85	25KHz Multi-vibrator
Q21	2SC372	61	85	100KHz Calibrator
Q22	2SC971	61	293	Regulator
Q23	2SC373	212	85	AF Amp.
Q24	2SC735	210	289A	AF Driver Amp.
Q25	2SB405	53	158	AF Power Amp.
Q26	2SC968	47	123A	AF Power Amp.

*All may not work - OBSERVE CORRECT EBC Markings

XIII. REMEDY FOR 31-METER OVERLOAD

One of the simplest ways to prevent overload in the RF section is to bleed off some of the signal before it becomes amplified. Examine the RF board drawing of page (6) and find overload diodes D1 and D2. These diodes pass strong signal blasts and spikes to ground whenever they exceed .2 volts. This seems very strong, but nice to know they are there in case static charge builds up for some reason.

In the same vicinity of the diodes, locate also touch-points #4 and #5. On the underside of the chassis, install a .00l/50V Mylar capacitor between touch-point pin #4 and #5. This may be too much reduction in RF for other normal bands; therefore the capacitor may be installed with a toggle switch to disconnect it when other bands are used.

XIV. TRANSPOSING CRYSTALS FROM LOWER RANGE INTO UPPER RANGE AND BACK

In the author's case, I moved the 31-meter crystal option up into the high range to avoid overload problems. The reason is because the RF coils for 3.5 to 10.0 MHz cannot adequately cover that range with the variable capacitor used in the preselector - physics just won't allow it. If the RF coils are tuned to receive, say down to 3.5, then the highest possible frequency that can be peaked is 10.5 MHz. This is coverage at the opposite extreme ends, and it is not very efficient.

Examine the chassis bottom view on page (5) and locate switch l. There are two wafers closest to the front of the receiver. On each wafer, unsolder the purple wire and leave them alone for the moment. Next, unsolder the two blue (11.5 MHz) wires and shift them up to the old purple tabs. Next, unsoldered the two green (9.5 MHz) wires and shift them up to the old blue tabs. Now re-soldered the two purple wires (l2 MHz) to the vacated remaining tabs. You have now moved the 11.5 crystal up into the 14 MHz spot, and moved the 9.5 MHz crystal up into the 11.5 spot, and the 14.0 MHz crystal down into the old 9.5 spot. This leaves some work to do.

Since we do not need the 14.0 MHz for SWBC DX work, I elected to remove it and replaced it with a 90-meterband 3.0 to 3.5 MHz crystal. Of course I had to also alter the capacitor as well. See notes of modification I.

Since we have moved the 9.5 MHz crystal to the upper range, we find that tuning the preselector does not quite tune down below 11 enough to get into the 31-meterband. Remember, we are tuning in the upper range now for the 31-meterband. Therefore we must retune the RE coils L4, L5, and L6 (see page 6, RF board) with a plastic tunetool. With selector on 31-meterband and the dial on a 100 mark, engage the crystal calibrator for highest meter deflection. Back off the RF gain to 1/2. Slowly, unscrew the ferrite cores upward with the tunetool until meter registers highest. (Don't forget to tune preselector to a position down below the 11 so as to allow the 31-meterband to be included. You will find that the slugs come almost even to the top of the coil cans. Then tune up to the range of about 27MHz (also switch to 27MHz crystal) Note that preselector peaks well on up above where normal peak should be. Then adjust the three-capacitor screws on the pre-selector ganged variable capacitor to get highest peak.

XV. TUNING OUT-OF-BAND RANGES BY VF0 HARMONIC TECHNIQUE

The VFO itself tunes from 2920 at zero down to 2420 at the 500 mark. The second harmonic is 5340 KHz. By adding this latter figure to the frequency position chosen we can tune BACKWARDS into some out of band ranges.

For instance, note that 3.5 MHz and 5.84 MHz equals 9.340 MHz. Therefore we can tune in an unusual range of 9.340 MHz to 9.840 MHz, it will backwards, with the lower end being at 500 and the higher end being at zero.

The 4.5 MHz position yields extra coverage of 4500 + 5840 = 1034O up to 10840. Remember though, it’s backwards. If you elect to purchase a 3.0 MHz crystal, it will yield 8.840 up to 9.340. The same theory works on the upper range positions as well. You also have to mistune your preselector to cover just about the range of the out-of-band portion you want. Try it. With practice, you should be able to easily tune in Israel on 9.009 or Vietnam on 10080. Mistuning the 11.5 MHz crystal position, I have also found AIR India on 17385 MHz.

XVI. ADJUSTING VFO TO INSURE GOOD DIAL ALIGNMENT

Examine the page (5) chart and locate the VFO section. Carefully identify positions of T7 and TCl4. You will need a tuning hex tool, and either a plastic or fiberglass screwdriver. Disconnect the antenna and adjust RF gain so that a 100 KHz crystal calibrator marker is about halfway. Start with the zero dial position and adjust TC14 so that the dial needle centers precisely on zero. Tune up to 400. Adjust T7 so that the meter reads highest when dial needle is precisely on 400. Retune down to 100. Re—adjust TC14 to get meter reading. Re-adjust dial up to 400 and peak T7 again. Do this back and forth until dial is exact at each end. Do NOT confuse which hole to tune for 100 and which to tune for 400. If you get it wrong you are in trouble. TC14 is for the low end and T7 is for the high end.

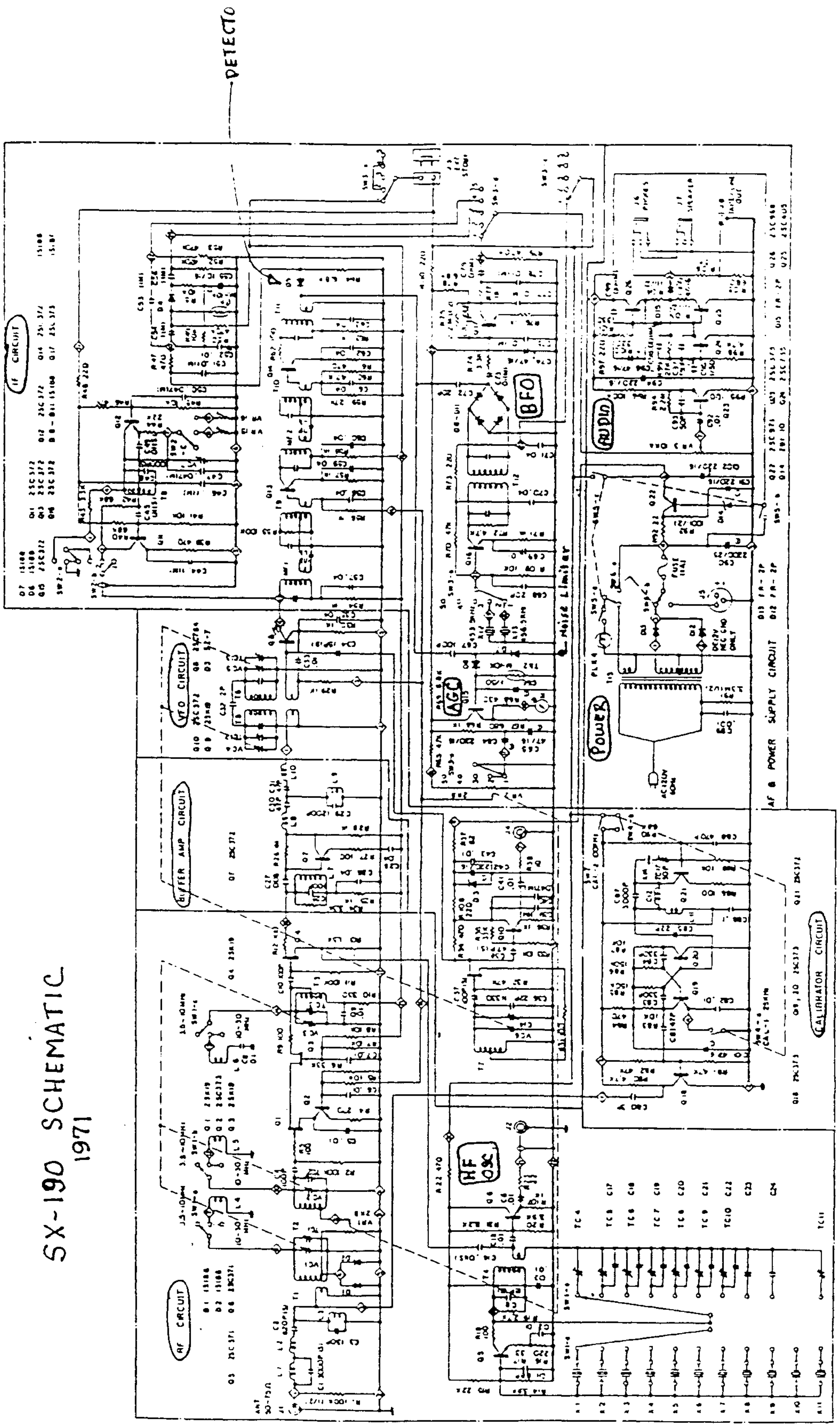
As an aid, you might consider purchasing the proper tools before you get started. Don’t use metal tools as they de-tune the coils and cause erroneous readings.

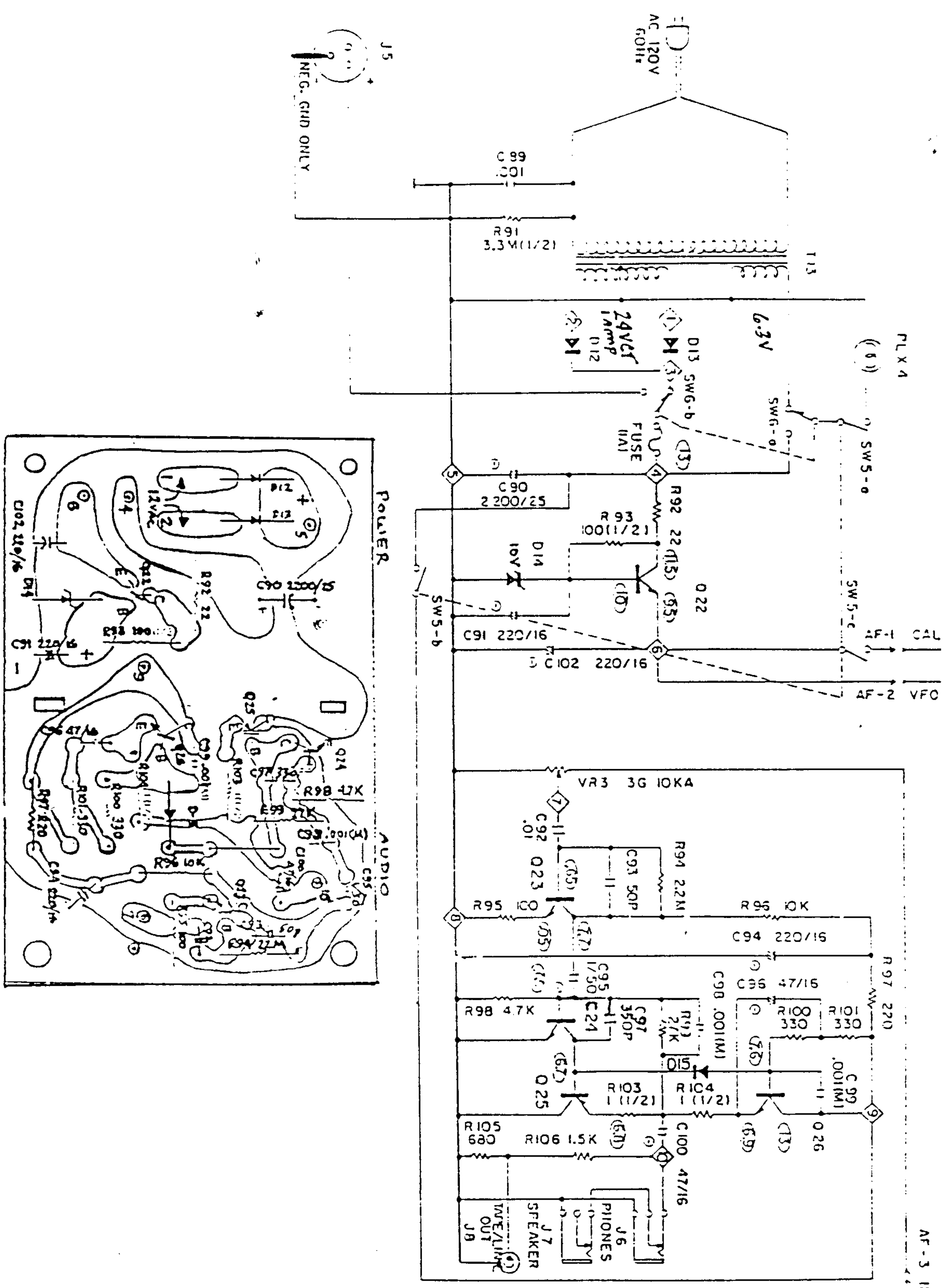
XVII. PEAKING RF STAGES FOR PEAK RECEPTION

Some of this is repetitive from a previous modification. The proper way to tune in a receiver is to have a signal generator. Failing that, we need only to get a steady WWV (5 MHz) or 3.33 MHz CHU signal, centered exactly. Adjust RF gain so that meter reads about halfway. Examine the RF board page (6) and locate T1, T2, and T3. Adjust these for highest meter readings. For the upper range, we have discussed how to tune the coils L4, L5, and L6 and then the variable capacitor trimmers for peak.

Don’t mess around with L1, L2, or L3. These are trap coils to filter out the frequency range between 2420 and 2920 (VFO range).

SX-190 SCHEMATIC
1971




AC 120V 60Hz
J5
NEG. GND ONLY
C89 .001
R91 3.3M(1/2)
T13
6.3V
24VCT 1Amp
D12
D13
SW6-b
SW6-a
FUSE 1(A)
SW5-a
C90 2200/25
R93 100(1/2)
R92 22
D14 10V
Q22
SW5-c
SW5-b
AF-1 CAL
AF-2 VFO
C91 220/16
C102 220/16
VR3 3G 10KA
C92 .01
Q23
C93 50P
R94 2.2M
R95 100
R96 10K
C94 220/16
R97 220
C96 47/16
R98 4.7K
C97 350P
R100 330
R101 330
D15
Q25
R103
R104
Q26
R105 680
R106 1.5K
C100 47/16
J6 PHONES
J7 SPEAKER
J8
AF-3 IF
POWER
AUDIO

XVIII. ADJUSTMENT OF 455 KHZ I.F. (ONLY IF NECESSARY)

Examine the page (6) I.F. board drawing and locate MF-1 and MF-2 and T-9 and T-10. Remove antenna. Dial up a 100 mark, turn on calibrator, and adjust RF gain to halfway meter deflection. Turn on Q-multiplier to center the frequency in as best you can. Using a plastic or fiberglass tool, carefully adjust each of the four mentioned components one after the other. Meter reading should already be as high as it could be, out that’s what we are after. Tune each of MF-l, T-9, MF-2, and T-10 in succession, several times until highest meter reading is obtained.

XIX. ADJUSTMENT OF Q-MULTIPLIER AND NOTCH FILTER.

As for above, tune in a calibrator marker, using Q-multiplier, get the highest reading on meter. Examine page (6) I.F. board drawing and find VR15 and VR16 near the front portion of the board. They are small adjustable resistors. With Q-multiplier in peak, adjust VR16 until meter is highest reading and tune knob (just to the left of selector) until it just begins to whistle when you tune left and right. In Notch mode, adjust VR15 until meter registers lowest reading.

In case you just have to repair a Q-multiplier, T8 is the oscillator coil. It can be adjusted to give a slightly tighter "Q". Don’t monkey with it if you don’t understand what you are doing. If you bust the ferrite slug, you have no more Q-multiplier.

XX. REDRILLING THE FACE PLATE FOR MORE CONVENIENT REMOVAL.

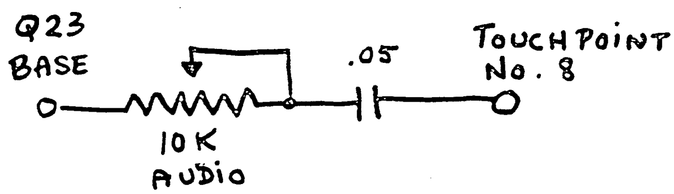
Remove all knobs from face of receiver. Unscrew the four screws holding the faceplate. Note that the shaft nuts of the phone jack, band selector, and mode selector also hold the faceplate secure. Carefully remove all these and let the faceplate come away. Replace the shaft nuts on the phone jack, band and mode selectors. Using a cone-shaped reamer drill, enlarge those holes so that when the faceplate is replaced, the shaft nuts will be exposed in the newly enlarged holes and will not impede the faceplate from seating flat, as it should.

While the faceplate is off, you may desire to drill two auxiliary 1/4" holes just to the left of the mode selector for installation of small toggles switches for auxiliary uses and other modifications. Hold the faceplate in position just long enough to drill through it and the underside steel face. Set faceplate aside and the install your toggle switches. Enlarge the new holes in the faceplate with the cone reamer if necessary to fit over the toggle switch shaft nuts. Such switches can be used for the dial light option, for instance.

XXI. ADDING A TONE CONTROL FOR AUDIO OUTPUT

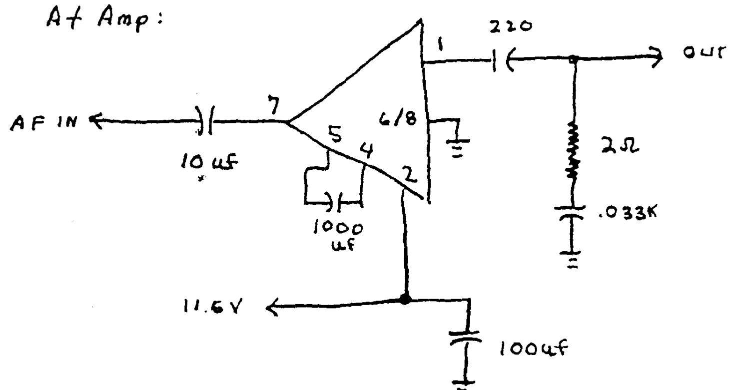
Finding a place to install the tone control may be the hardest thing about this project. To increase the bass response, install a non-polarized capacitor of about 1 to 5 uF value between the base of Q-23 and touch-point #3. Examine the audio schematic on page (15). To increase treble response, install a capacitor (ceramics will do) of about .01 to .05 uF value in series with one lead of your audio output - or in one leg of your headphone wires.

Another rudimentary tone control which might be tried is to put a 10K audio pot and a .05 uF capacitor in series, then wire it in between the Q-23 base and ground (touch-point #8). This would work for an amplifier with somewhat higher impedance input than the SX-190 amp has, so it might not be too effective.

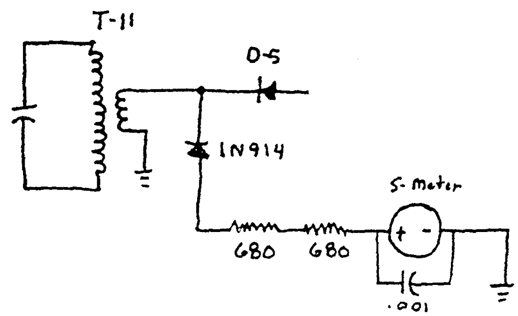


MOD NOTES...

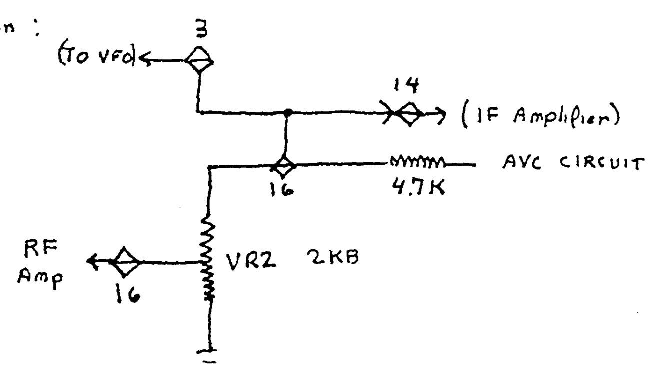
I. Af Amp:



II. S-meter Mod:



III. RF Gain:



SPECIAL feature

GETTING REACQUAINTED WITH THE SX-190

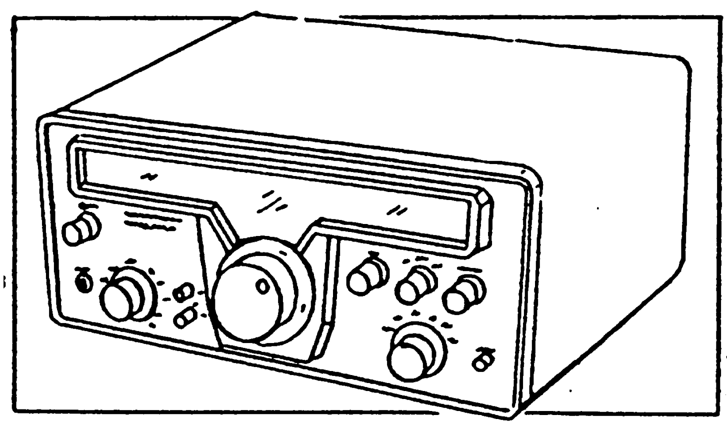
by EDWARD SHAW

This is a receiver, which I got to know intimately. I have been inside and out of it for several years, making repairs, alterations, and experimental changes for entertainment. As one top NASWA DXer expressed it, "It (the SX-190) is an experimenter’s delight!"

SX-190 (and its AX–190 amateur band twin) was manufactured for Radio Shack in Japan. It very nearly is the same receiver circuit as the Hallicrafters SX-117 of ten years ago. The SX-l90 probably was the most advanced receiver for the price. Today, it still compares favorably with the most popular serious DX machines. Some experienced DXers feel -that the SX-190’s 60 meter prowess is unsurpassed. It was the first receiver to include most of what every DXer needed. And, whatever was missing could be easily added.

It was a crystal controlled, VFO receiver with preselectior not just advance RF amplification. It had crystal controlled Upper and Lower Side Band ability. It had a TUNEABLE IF pass band with either a Q–peak or T-notch. Frequencies could be read with visual accuracies of about 100 cycles - that’s CYCLES, I said! They are available only on the used market now. In Australia, I’ve heard of prices like $480 U.S. being paid for them. Originally, in the U.S. they sold for $250, and then were sold on clearance sale for $170. I have two and will not part with them.

As it came, the SX–190 had crystals to provide reception on 75, 49, 41, 31, 25, 19, 16 meters; also 20-meter ham and 11 meter CB. Two blank spots were available for installing your choices of any two other segments of 500 KHz. Most persons opted for a crystal to provide the 11.5 to 5.0 MHz band of 60 meters.



Additionally, though the receiver manufacturer said "down to 3.5 MHz", the SX-190 actually covered down to 3.0 MHz easily. Many purchased the crystal to provide 3.0 to 3.5 MHz (90 meters) which is filled with the richness of Latin's, Africa, and far South Pacific islands.

The sharp selectivity of the IF enables the DXer to hear powerful signals even as close as every 5 KHz. Only the most advanced and expensive rigs can do that today. One could even dial in more frequencies than they had crystals for, too. The preselector could be deliberately mistuned to provide additional bands of frequencies. For instance, the 75-meter crystal normally provided 3.5 to 4.0 MHz coverage. But, deliberate mistuning could also make it provide 9.34 down to 8.84 MHz. It was some minor inconvenience to read and figure frequencies backwards, but then I was able to pick up many stations in that band....Israel on 9.009 KHz for instance.

I wish that a synthesized version would appear on the market! (Cont’d)

GETTING REACQUAINTED WITH THE SX-l90 (Cont'd)

There are some tricks to allow extra coverage. Each of the crystals in the SX-l90 can be deliberately mistuned in a higher range. For instance, the 3.5 MHz crystal provided with the SX-l90 nay be mistuned on the preselector for a range of frequencies between about 9,340 KHz and 8840 KHz. Try it! Notice that the preselector peaks at two places...once at about 3.5 for normal use, and again above 9.0 MHz! With your tuning knob on zero, peak the preselector to highest level on the S—meter. Then slowly turn your tuning knob clockwise. (Punch in your 25 KHz calibrator). You will get a calibrator signal about ten KHz away from the zero point. This is really 9,350 KHz. Notice again that the scale of frequencies on this mistuning trick run backwards, descending in frequency to the 500 KHz spot on your tuning dial. 9.009 KHz Israel can be found in this manner at about 331 on the tuning dial. Below are some ready—figured scales for your convenience. Actual frequencies obtained are shown.

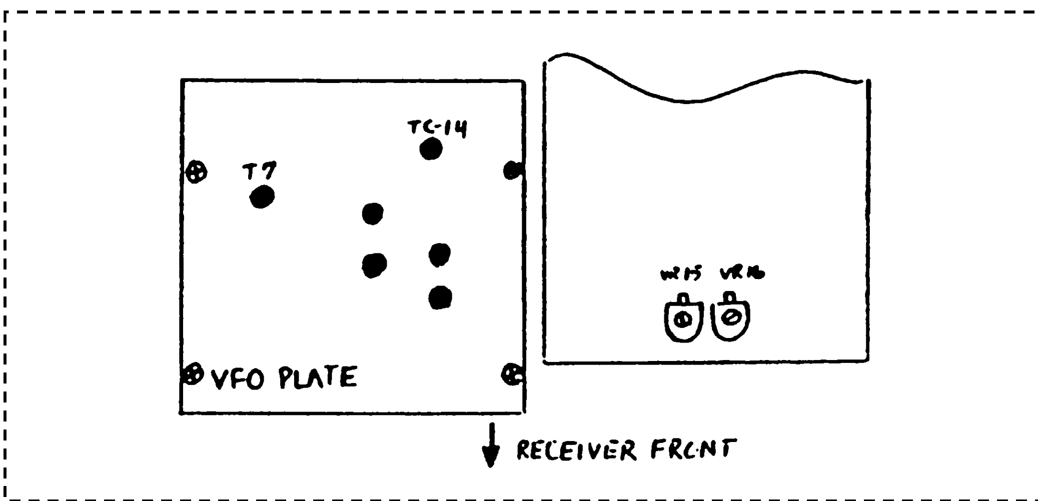
Crystal	**0**	**100**	**200**	**300**	**400**	**500**	**Dial Number**
3.0 *	8.84	8.74	8.64	6.54	8.44	8.34	
3.5	9.34	9.24	9.l4	9.04	8.94	8.84	
4.5 *	lO.34	10.24	10.14	10.04	9.94	9.84	

*These crystals do not come with the SX-l90, but some people have acquired them from sources on their own for additional coverage.

Mistuning in the higher range of frequencies is accomplished in the same way, but readers can make a chart of their own if they desire to do so.

REALIGNMENT AND PEAKING PROCEDURES

To realign the main dial, you will first need some tuning, tools from the local electronics store. Radio Shack has an adequate set for about $2.
Open your receiver cabinet and examine from the top, front toward you.
We are interested in the center VFO section. It has the appearance of a metal box with a screwed-down metal plate on top and having holes in it.



Examine the illustration above. Note that the extreme left hole is designated T—7 and the extreme upper right hole is designated TC-11. The left hole is centered over a ferrite slug tuned coil, which is adjusted with the hex tipped plastic tool from your new tool set. Try each until you find one that fits. NOTE: Before we go further, it may be useful to get a pocket penlight flashlight for aid in seeing into the VFO cover holes in order to place your instrument tool correctly. The upper right hole is centered over a trimmer condenser, which is tuned with a plastic screwdriver.

Now we are ready to begin:

1. Receiver should be warmed up 30 minutes before starting work.

2. Connect your antenna.

3. Control settings: RF gain full clockwise; AF pain adjusted to comfortable level; Band Selector on 15 MHz; Function switch on AM: Q—Multiplier is OFF.

4. Tune main dial to receive WWV on 15 MHz. Normally, it should be at Zero on the dial.

5. If it is not on zero, adjust the TC-14 (upper right hole) until WWV is centered precisely.

6. Remove antenna... no longer needed. Push 100 KHz calibrator button. If S—meter is too far to right, back off RF gain until needle indicates about S-6. Leave calibrator ON.

7. Tune main control to 400 and search for calibrator signal. If not precisely on 400, adjust the T-1 (left hole) until signal appears precisely on 400.

8. Tune main control dial back to zero-calibrator signal will possibly be off-center again. Readjust TC-14 until calibrator signal centers on zero.

9. Repeat step (7), then repeat step (8), etc. until the calibrator signal remains centered precisely at the zero and 400 marker spots.

CAUTION: Remember that the T—7 adjustment is ONLY for the 400 marker spot, and the TC—l4 adjustment in ONLY for the zero marker spot. If you confuse the two, erroneous adjustment will result and you will have to start all over again.

Q-MULTIPLIER ALIGNMENT

Now we are concerned with two small variable resistors on the right side of the receiver's circuit board. These are identical components located immediately behind the S—meter. They appear as side-by-side semi-circles illustrated as VR—15 and VR—l6.

1. Control settings: RF gain full clockwise; AF gain full counterclockwise; Function switch on "AM"; Calibrator-ON; 100 KHz is on 100 KHz.

2. Put Q—multiplier switch to "Reject" position.

3. Adjust VR—15 (nearest to center of receiver) until minimum signal is obtained on the S-meter.

4. Put Q—multiplier switch to "Select" position.

5. Adjust VR—16 until highest S—meter reading is obtained. Readjust RF gain knob until needle drops to S-3 or S-4.
6. Leave switch in "Select". Adjust tuning knob left and right to observe whether or not there is any squeal. If no squeal, you are O.K. If squeal is noted, readjust VF—16 to slightly less S-meter reading until squeal disappears during tuning.

From "THIS & THAT" NASWA 7-80

Paul Kowolskl, 1557 N. Farwell Ave., Apt. 105, Milwaukee, WI 53202, writes to us regarding tuning the SX-190 receiver. As Most SX-190 owners probably know, the preselector can be mistimed to receive certain out of band frequencies. Ed Shaw, I believe, had an article on this some years ago. As he said these trick frequencies tune backwards...

I've found a way to receive further coverage involving preselector tuning and this is very useful. Coverage on the 11.5 MHz range can be either fundamental 11.5, 17 MHz will be the next "backwards reading" one, and then 26 MHz! And the 26 MHz range reads normally left to right. The 100 KHz crystal marker points will however be approximately 20 KHz behind the calibrated main spread dial.

To receive the 26 MHz band, first set the band selector to 11.5, then tune the preselector to between 27 and 25 and peak the background noise. Next put on the crystal calibrator and tune approximately in the vicinity of 180-200 on the main dial and listen for the crystal signal. When located, peak the preselector and adjust the dial skirt to 0. You will now be tuned to 26000 KHz. Daytimes tune up 20 kHz and you will find HCJB's 100 watter. As I said before, the main tune dial will be a bit behind actual markings, but the whole band is quite accurately tuned if you calibrate via crystal and use the dial skirt scale. Remember that, unlike the second 'trick' setting that reads backwards, this third one reads normally left to right. So if you want 11-meter coverage, don’t waste, money on a crystal. The SX-190 will get most of it down to nearly 25800. Tests with the crystal marker shows it to read fairly linear much the same as normal band reception.

****

From 8-74 NASWA WORK SHOP PROJECT

The last workshop articles for the SX-190 receiver were well liked and we thought that a few additional items would be appreciated, too. I am sure many of you feel unqualified to monkey around inside your receiver, but once the following alteration is somehow accomplished, there will be no more need to change capacitors whenever you decide to install another or change to different crystals for additional coverage on your SX-.190.

The only part you will need is a variable capacitor capable of tuning up to approximately 900 pf. If this seems difficult to locate, there is a way around it - and, I'll tell you how later. But for now let's assume you do have the variable capacitor in hand.

Step 1: Remove the top and bottom of your receiver, and turn it bottom side up with the front you.

Step 2: Carefully unscrew and remove the HF OUT plug from the rear panel of receiver - do not snip any wires. Wrap the loose plug in a small piece of folded Saran-wrap and secure with a rubber band. This plug may lie loose within the interior of the receiver with the plastic bag protecting it from any short-circuiting.

Step 3: Remove the front panel-retaining ring from the headphone jack, then remove the jack from that hole and reposition it in the vacated hole on the rear of the receiver. You will need a larger diameter washer to hold it in place before replacing the retaining ring screw.

Step 4: In the front panel hole you may install your variable capacitor. Some variable capacitors have a threaded shank to push through the hole like the phone plug did; others may have to be cemented into place.

Step 5: Solder the varicaps ground connection to the common ground shared by all the crystal capacitors. Solder the fixed plate connection to the crystal selector wafer switch inner contact ring.

Step 6: If you succeeded in finding a true 900 pf variable capacitor, all individual crystal capacitors may be removed. If you were not able to find a 900 pf, you will need to install individual capacitors on the lowest few crystal positions in values sufficient to total 900 pf when added to the value of your variable capacitor. In practice, I found that a 365 pf varicap may be used, leaving a 600 pf fixed capacitor on the lowest blank option, and 300 pf capacitor on the 3.5 crystal position.

TECHNICAL TOPICS
6-82

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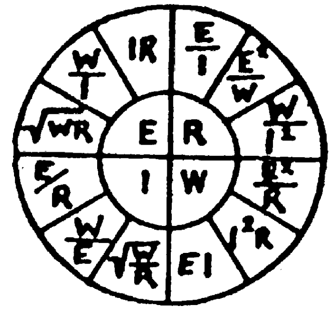


ALLIED SX–190 REVISITED: A Nostalgic Review of Radio Shack’s "First Try"

I am the first to admit that Radio Shack’s first try was their best... they should have stuck to it. SX-190 and the amateur band sister AX-190 appeared on Radio Shack’s shelves rather suddenly as I recall about the summer of '71 and for $299.95, including the crystals. My first purchase was a dog, and the knowledgeable technician they employed devoted a lot of time to study of the new schematics and poking around inside. As it happened, I ended up with a replacement RX that had none of the bugs plaguing the one I turned in. It was everything I wanted in a receiver at the time. It still has lots!

The SX-l90 was the first SWL DXing receiver, which was a serious attempt to provide a meaningful tool with first-class features. As it comes stock, crystals are provided for the 75, 49, 41, 31, 25, 20, 19, l6, & 11 meter bands. Options were left blank for the owner to install his own desires. Most NASWA owners opted for a 60 meter and 13 meter crystal. Others found innovative ways to install external crystal sockets which then afforded convenient methods of switching crystals for yet further coverage. In reality, the SX-190 could also cover down to 3.0 MHz, the 90-meter band.

A large, weighted main tuning knob was graduated in 1 KHz notches, with even finer 200 cycle divisions around the edge. SX-190 boasted a Q-multiplier and a notch filter, both of which worked admirably. Upper and lower sideband was readable with rock-stable crystal-controlled selectivity. The VFO was also rock steady, and frequency did not drift one cycle off, unlike modern stuff, which wows and whines whenever you put a hand near the cabinet.

Yes, SX-190 worked well... for most. Some few had problems like my first one. Many others also did and continue to have a minor overload problem, but only on the 31-meter band. The reason has basically to do with the RF coils used in the SX–190. 31-meters was just about at the upper limit of that coil's resonance. To have made it better would have sacrificed the lower frequency range, or the SX-l90 would have been redesigned to have three overlapping ranges instead of only two...thus increasing the design costs. Some of us have since done a lot of redesign and mod-work. In any case, the 31 mb overload problem was simply offset thru use of a higher-impedance or shorter antenna wire fed thru a tuner.

Other features included two calibrator signals of 100 KHz and 25 KHz. I promptly altered the circuit to give 5 KHz signals instead of 25 KHz. To use the SX-190 on battery power during field trips, I installed an external toggle switch to turn-off the dial lights (which use 4 times the power as the receiver does). Using the technical manual, it is easy to realign and peak one's own SX-19O.

Those receivers should be selling used for just about same as new price, it the receiver is in mint condition. If you can find one under $200 jump on it. In my opinion, the SX-190 is vastly superior to any receiver, on the present market for $300.00 or less EVEN CONSIDERING that SX-190 is not digital and only provides segment coverage by crystals.

ALLIED RADIO SHACK

3.5-30 MHz AM CW SSB COMMUNICATIONS RECEIVER

MODEL	AX - 190	CAT. NO. 20 - 5155
MODEL	SX - 190	CAT. NO. 20 - 5190

SERVICE MANUAL

A PRODUCT OF RADIO SHACK

A TANDY CORPORATION COMPANY

CONTENTS

1. General Specification

Number of semiconductor	4FET, 22TR, 13 diode, 2 Zener and 2 thermister
IF Frequency	2.920 to 2.420 MHz (Variable) and 455 KHz
Reception	AM, CW, and SSB
Sensitivity (AM)	Less than 1 microvolt for 10 db S/N ratio
Sensitivity (SSB)	Less than 0.5 microvolt for 10db S/N ratio
Selectivity	4 KHz at 6 db down
Visual dial accuracy	±200 Hz
Calibration accuracy	Better than ±500 Hz adjacent 25 KHz calibration points after indexing
Stability	Better than 500 Hz after warm-up
Image rejection	More than 60 db
Spurious rejection	More than 50 db
Rejection tuning	More than 40 db
Selection tuning	500 Hz at -3 db
Audio output power	Maximum 1 watt at 8 ohm load
Audio output impedance	8 ohm and 600 ohm
Headphone output	8 ohm standard 1/4 inch plug
Ant impedance	50 to 75 ohm unbalanced
Power source	120 V AC 60 Hz and 12 VDC
Power consumption	10 watts
Remote stdby control	Rear-mounted: 2 pin connector
Dimensions	7” high, 15” wide and 10” deep

2. Disassembly Instructions

Remove all black screws then cabinet will be open.

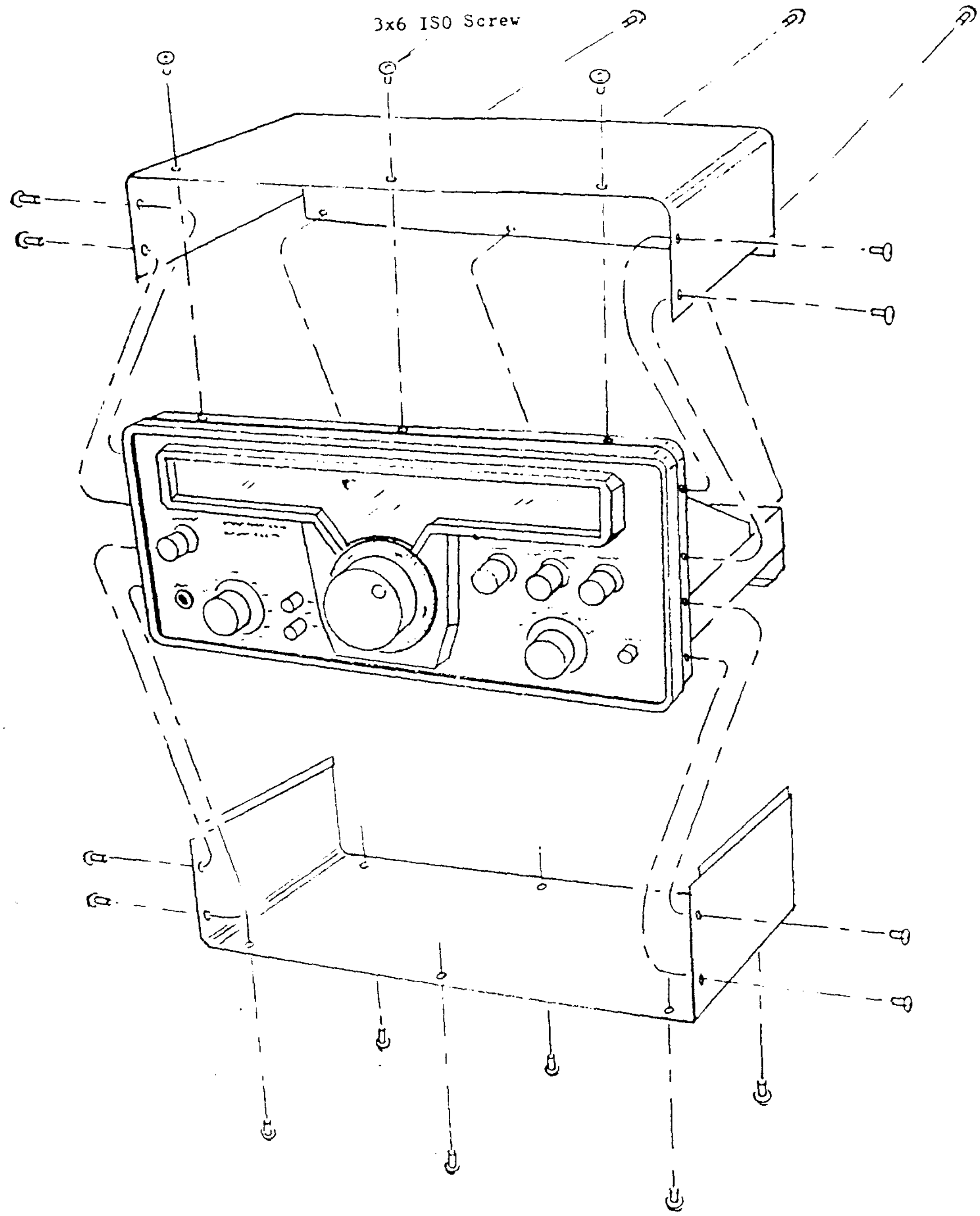


Fig. 1

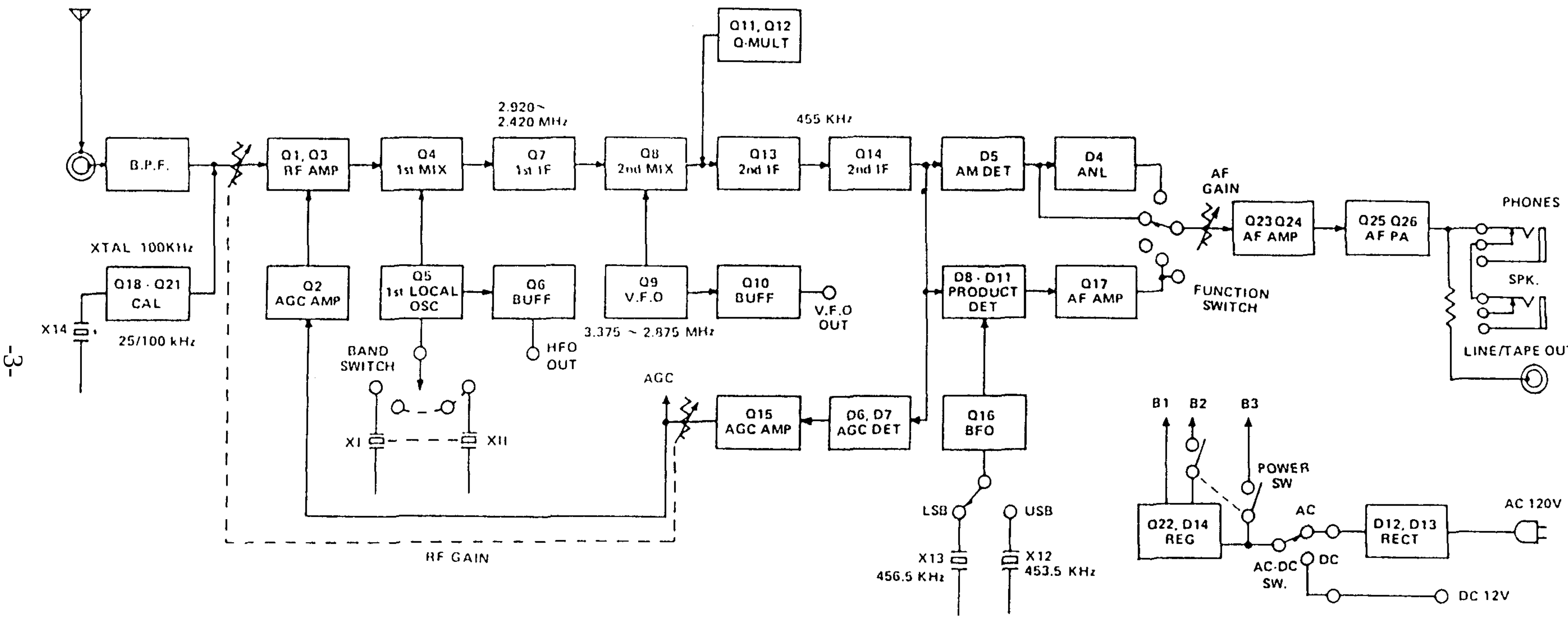


Fig. 2 **BLOCK DIAGRAM**

Alignment Procedure:

455 KHz 2nd IF Amplifier

Method 1 (Using Sweep Generator)

(1) Control Settings:

RF Gain	-	Full Clockwise
AF Gain	-	Max. Counterclockwise
Band SW	-	Any band
Function	-	AM
Q-Multi	-	OFF
CAL	-	OFF

(2) Connect the Sweep Generator output to the hot side of the VC5, which is located in VFO Box.

(3) Connect the oscilloscope to the Pin 10 which is IF output and it is located on the IF PCB.

(4) Adjust the Generator output to obtain a reading on the scope.

(5) Tune MF1(RED),T9 (YEL), MF2 (RED), Tl0 (YEL) and Tll (BLK) for peak and symmetry on the scope.

Method 2 (Without using Sweep Generator)

(1) Control Settings:

Band SW	-	Any band but additional band
Preselector	-	Adjust to the selected frequency band
Calibrator	-	100 KHz ON
Main dial	-	Tune to receive calibration signal
Function	-	AM
Q-Multi	-	OFF

(2) Adjust the RF Gain control to be read S 6 or 7 on the S-meter.

(3) Tune MF1, T9, MF2, T10 and T11 for peak on the S-meter, at this time adjust the RF Gain control to read S 6 or S 7 on the S-meter.

(4) Confirm that the S-meter reading is same or not when remove the main dial from "0" to -3 KHz and +3 KHz.

(5) If it is not, repeat step (3) until no interaction is observed and all transformers are turned for maximum gain.

2) 2.920-2.420 MHz 1st variable IF Amplifier

(1) Control settings:
RF Gain - Full clockwise
AF Gain - Adjust for desired audio level
Function - AM
Band SW - Any band but recommend 27. 0 MHz for SX-190 or 29.5 MHz for AX-190
Preselector- Adjust to the selected frequency band
Q-Multi - OFF

(2) Rotate the main tuning knob to "0" on the main dial.

(3) Connect the VTVM and 8 ohms dummy load to SPK jack.

(4) Connect the signal generator* to the antenna jack and adjust the frequency of the generator to the receiving frequency.
*The generator output must keep as low as possible during alignment.

(5) Adjust TC12, TC13 In the VFO box and L8, L10 in the buffer amplifier to maximum output.

(6) Rotate the main tuning knob to "500" on the main dial.

(7) Adjust the frequency of the signal generator to the receiving frequency.

(8) Adjust the T5, T6 in the VFO box and L9 in the buffer amplifier to maximum output.

(9) Rotate the main tuning knob to "250" on the main dial.

(10) Adjust the frequency of the signal generator to the receiving frequency.

(11) Adjust the L7 to maximum output.

(12) Repeat step (2) thru (10) until no interaction is observed and all transformers and trimmers are turned for maximum gain.

3) VFO Alignment
NOTE: Before the VFO alignment the set should be warmed up over 30 minutes.

Method 1 (Using frequency counter)

(1) Connect the frequency counter to J4 (VFO OUT) located on rear side.

(2) Tune the main dial to "100" to the centerline marked nothing.

(3) Adjust TC14 in VFO Box, to 3.275 MHz on the frequency counter.

(4) Tune the main dial to 450 to the center tine.

(5) Adjust the T7, in the VFO Box, to the exactly 2.925 MHz on the frequency counter.

(6) Repeat steps 2) thru 5) as necessary to obtain a frequency of 2.375 MHZ when the dial indicates "100" and a frequency of 2.925 MHz when the dial indicates "450".

Method 2 (Without using frequency counter)

(1) Control settings:
RF Gain - Full clock-wise
AF Gain - Adjust for desired audio level
Band SW - 15 MHz Band
Preselector - 15 MHz
Function - AM
Q-Multi - OFF

(2) Connect the antenna to The J1 ANT jack.

(3) Tune the main dial to receive WWV signal that is exactly 15.000 MHz. Normally it will be heard at dial "0" on the main dial.

(4) If it is not there, adjust the TC14 in the VFO Box to be receiving the WWV signal on the dial "0".

(5) Before using the calibrator signal, make sure that the 100 KHz calibration signal is correct or not. If it is correct zero beat sound is heard, if not adjust the TC17 on the CAL PCB to be hear zero beat sound.

(6) Remove the antenna; push the 100 KHz CAL knob and if the S-meter indicates over S 9 adjust the RF Gain control to be read S 6 or S 7.

(7) Rotate the main timing knob and to receive the 4th calibration signal, it will be appeared near the "400" on the main dial.

(8) Adjust the T7 to receive "400" KHz calibration signal on the "400" on the main dial.

(9) Repeat steps (4) thru (8) as necessary to obtain a correct frequency on the main dial.

4) 1st local crystal oscillator (HFO)

(1) Connect the RF VTVM and frequency counter to the HFO OUT J2 located on rear side of the panel.

(2) Set the band SW to 29. 5 MHz position for AX-190 or 27.0 MHz position for SX-190.

(3) Tune T4, located on the RF PCB, for peak as indicated on the VTVM and also correct frequency. 32.420 MHz for AX-190 or 29.920 MHz for SX-190.

(4) Rotate the band SW to 29.0, 28.5, 28.0, 27, 21 and 15 MHz Band for AX-190 or 27.0, 17.5 and 15 MHz Band for SX-190 make sure that those frequency error are within 1 KHz.

(5) Rotate the band SW to 14 MHz and adjust TC7 to 17.920 MHz, rotate the band SW to 7 MHz and adjust TC6 to 9.920 MHz, rotate the band SW to 3.5 MHz and adjust TC5 to 6.420 MHz for AX-190.

Or, rotate the band SW to 14 MHz and adjust TC10 to 16.920 MHz, rotate the band SW to 11.5 MHz and adjust TC9 to 14.420 MHz, rotate the band SW to 9.5 MHz and adjust TC8 to 12.420 MHz, rotate the band SW to 7.0 MHz and adjust TC7 to 9.920 MHz, rotate the band SW to 5.7 MHz and adjust TC6 to 8.620 MHz, rotate the band SW to 3.5 MHz and adjust TC5 to 6.420 MHz for SX-190.

The oscillation frequency of each bands are follow.

Band	OSC Freq.
3.5 MHz	6.420 MHz
5.7	8.620
7	9.920
9.5	12.420
11.5	14.420
14	16. 920
15	17.920
17.5	20.420
21	23.920
27	29.920
28.0	30.920
28.5	31.420
29.0	31. 920
29.5	32.420

5) Preselector (RF) Amplifier

(1) Control settings:
RF Gain - Full clockwise
AF Gain - Adjust for desired audio level
Function - AM
Q-Multi - OFF
Band SW - 14 MHz Band
Preselector- Just on mark "14"
Main dial - Marked "0"

(2) Connect the VTVM and 8 ohms dummy load to SPK jack.

(3) Connect the signal generator to the antenna jack and adjust the frequency to 14 MHz.

(4) Adjust L4, L5 and L6 on the RF PCB to maximum output.

(5) Rotate the Band SW to 27 MHz Band, the preselector dial to just on marked "27" and main dial to marked "500".

(6) Adjust the frequency of the signal generator to 27 MHz.

(7) Adjust TC1, TC2, and TC3 on the 3 gangs preselector variable capacitor to maximum output.

(8) Rotate the Band SW to 3.5 MHz, the preselector dial to just on marked "3.5" and main dial to marked "0".

(9) Adjust the frequency of the signal generator to 3.5 MHZ.

(10) Adjust the Ti, T2 and T3 on the RF PCB to maximum output.

(11) Repeat steps (3) thru (10) until no interaction is obtained and all transformers and trimmers are turned for maximum output.

6) 100 KHz crystal calibrator

(1) Control settings:

RF Gain	-	Maximum clockwise
AF Gain	-	Adjust for desired audio level
Band SW	-	15 MHz Band
Preselector	-	15 MHz
Q-Multi	-	OFF
Function	-	AM
CAL	-	OFF

(2) Connect the speaker to the SPK jack.

(3) Connect the antenna to the ANT jack.

(4) Turn the main dial to 15.000 MHz to receive the WWV signal.

(5) Push the 100 KHz CAL knob listen for beat sound.

(6) Adjust the TC17, on the CAL PCB, to get zero beat sound.

7) Reject and Select Alignment

(1) Control settings:
RF Gain - Full clockwise
AF Gain - Full counterclockwise
Function - AM

(2) Receive one of the calibration signals.

(3) Q-multiplier SW to Reject position and set the tune knob to the center.

(4) Adjust VR15 on the IF PCB to minimum reading on the S-meter.

(5) Q-Multiplier SW to Select position.

(6) Adjust the RF Gain control to indicate S3 or S4.

(7) Adjust VR16 on the IF PCB to maximum reading on the S-meter but no oscillation when rotating the tuning knob.

8) LSB and USB Crystal oscillator

(1) Control settings:
RF Gain - Full clockwise
AF Gain - Adjust for desired audio level
Band SW - Any band but additional band
Preselector - Adjust to the selected frequency band.
Q-Multi - OFF
CAL SW - Push the 100 KHz knob
Main dial - Set to receive one of the calibration signal
Function - USB or LSB

(2) Connect the speaker to the SPK Jack.

(3) Tune lower core of T12 to get beat sound.

(4) The activity of the LSB and USB crystals (X11 and X12) should be approximately the same for both positions of the Function switch.

(5) Adjust the upper core of T12 to maximum audio output.

9) Trap Coil (L1, L2, L3)

(1) Control settings:
RF Gain - Full clockwise
AF Gain - Adjust for desired audio level
Band SW - 3.5 MHz
Preselector - 3.5 MHz
Main dial - "0"
Function - AM

(2) Connect the VTVM and 8 ohms load to the SPK jack.

(3) Connect the signal generator to the ANT jack and adjust the frequency to 2.920 MHz.

(4) Adjust L1 to minimum reading on the VTVM.

(5) Change the frequency of the signal generator to 3.500 MHz.

(6) Adjust L3 to 3 dB decrease point on the VTVM.

(7) Change the frequency of the signal generator to 30 MHz.

(8) Band SW rotate to 29.5 MHz, preselector dial to 30 MHz and main dial to "500"

(9) Adjust L2 to 3 dB decrease point on the VTVM.

5. Printed circuit board part location and its schematic diagram

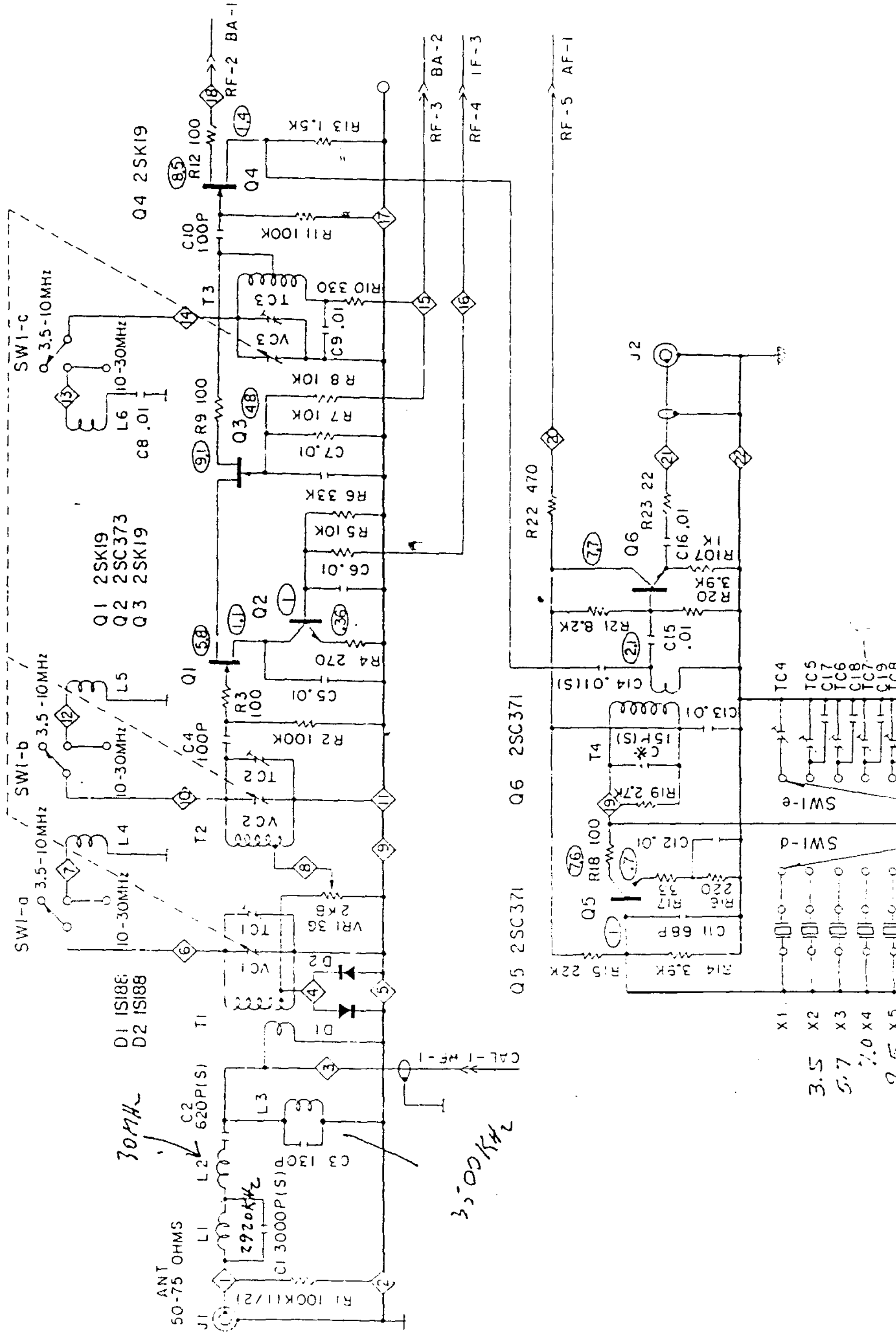


Fig. 5 RF Amplifier schematic diagram

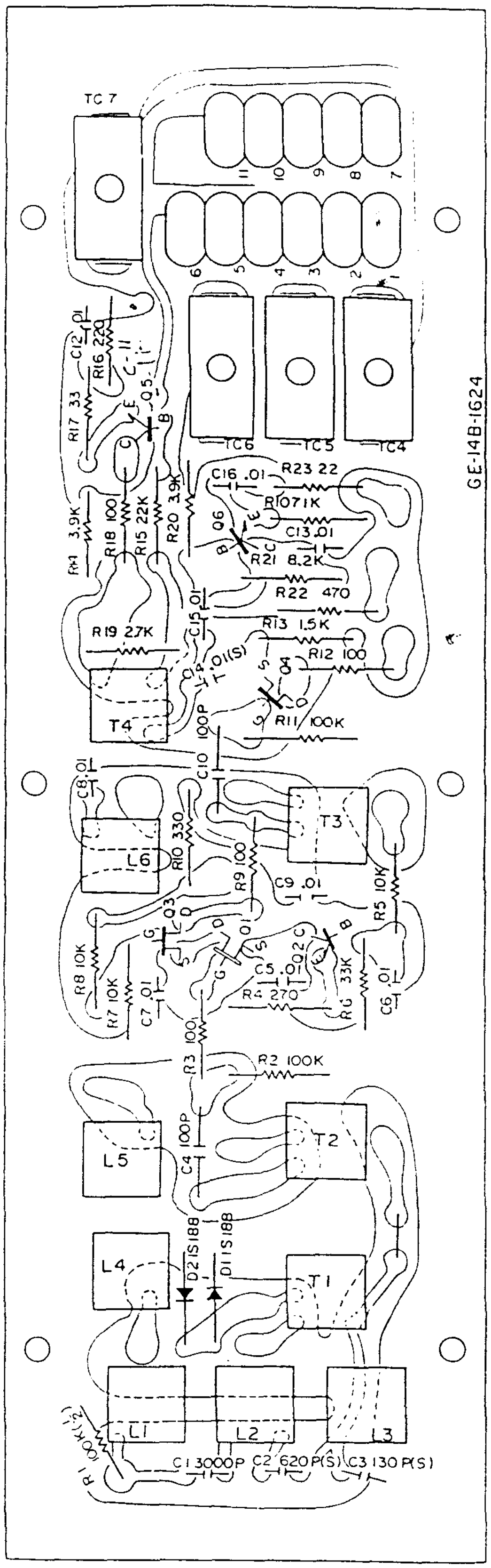


Fig. 6 RF PCB top view

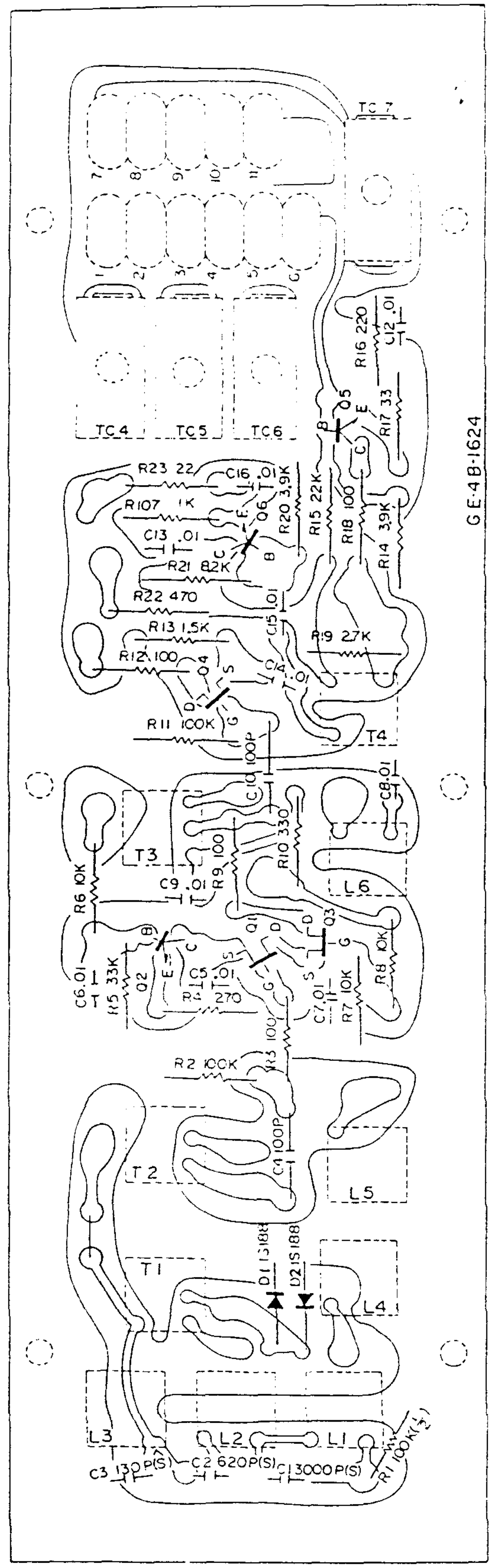


Fig. 7 RF PCB rear view

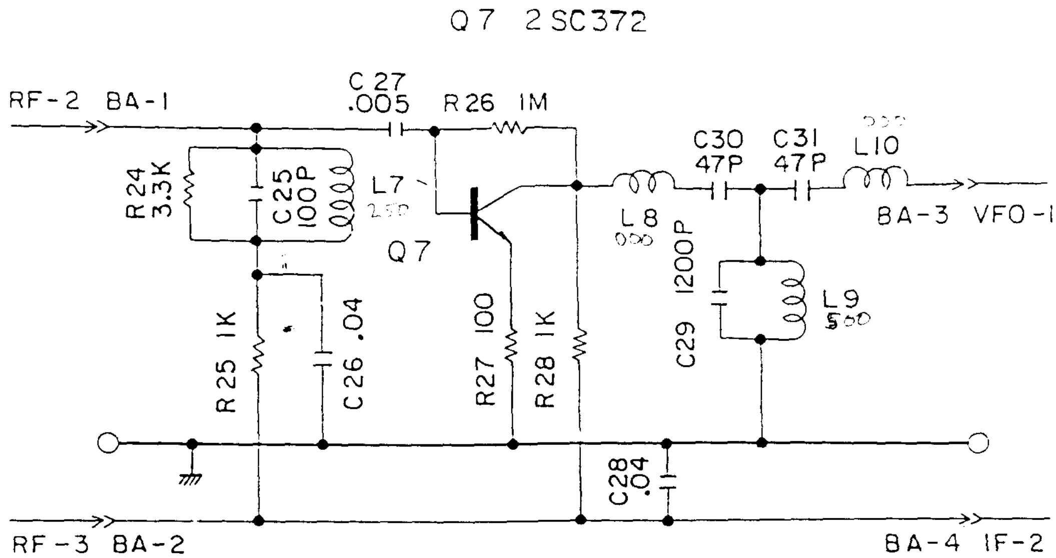


Fig. 8 Buffer Amplifier schematic diagram

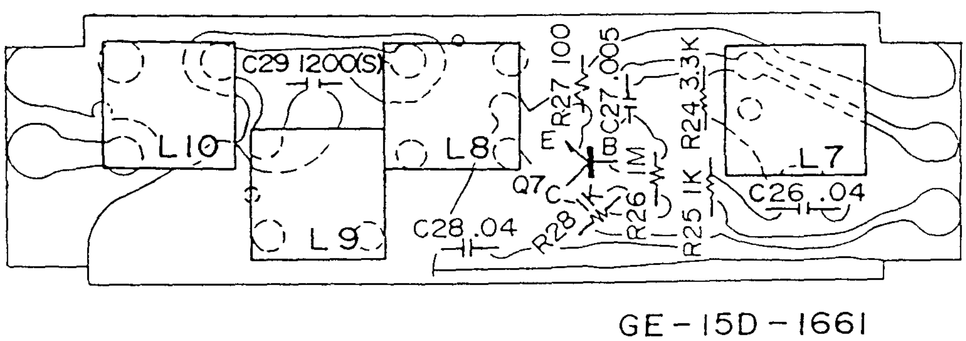


Fig. 9 Buffer Amplifier PCB top view.

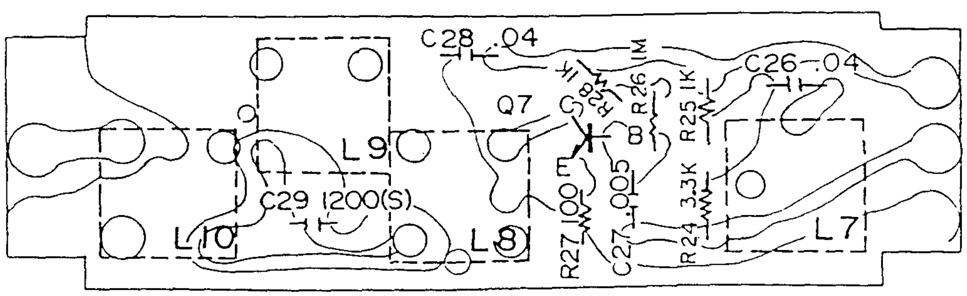


Fig. 10 Buffer Amplifier PCB rear view

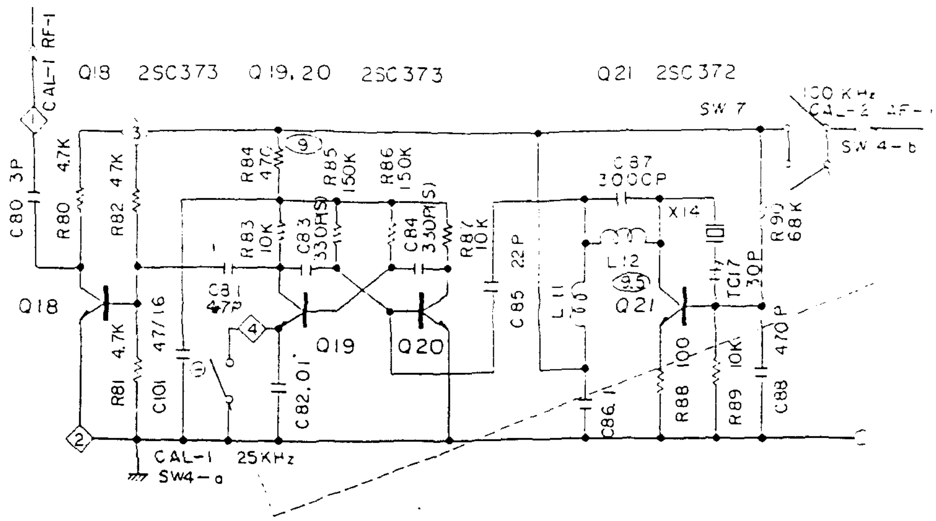
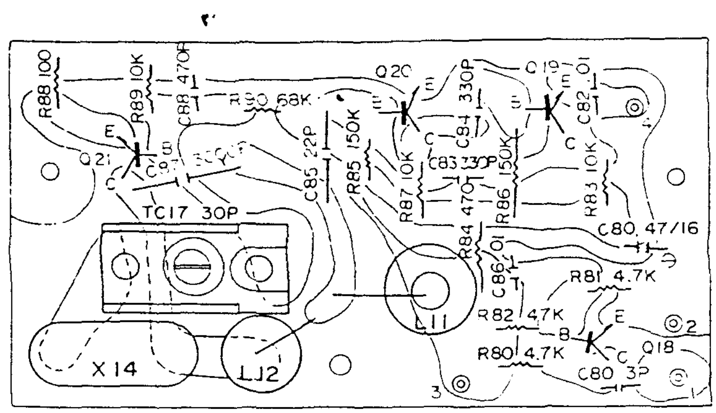


Fig. 11 Calibrator schematic diagram



GE-15D-2163

Fig. 12 Calibrator PCB top view

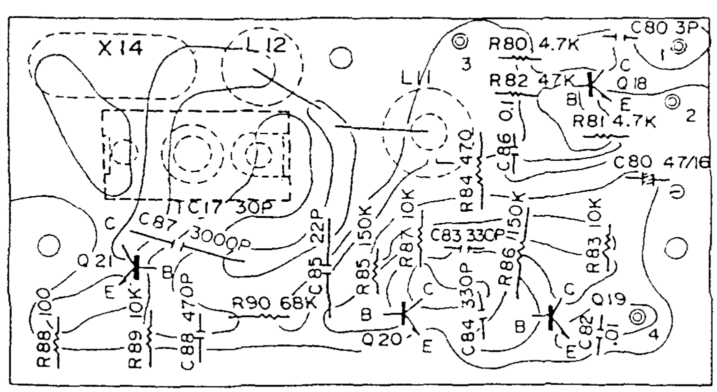


Fig. 13 Calibrator PCB rear view

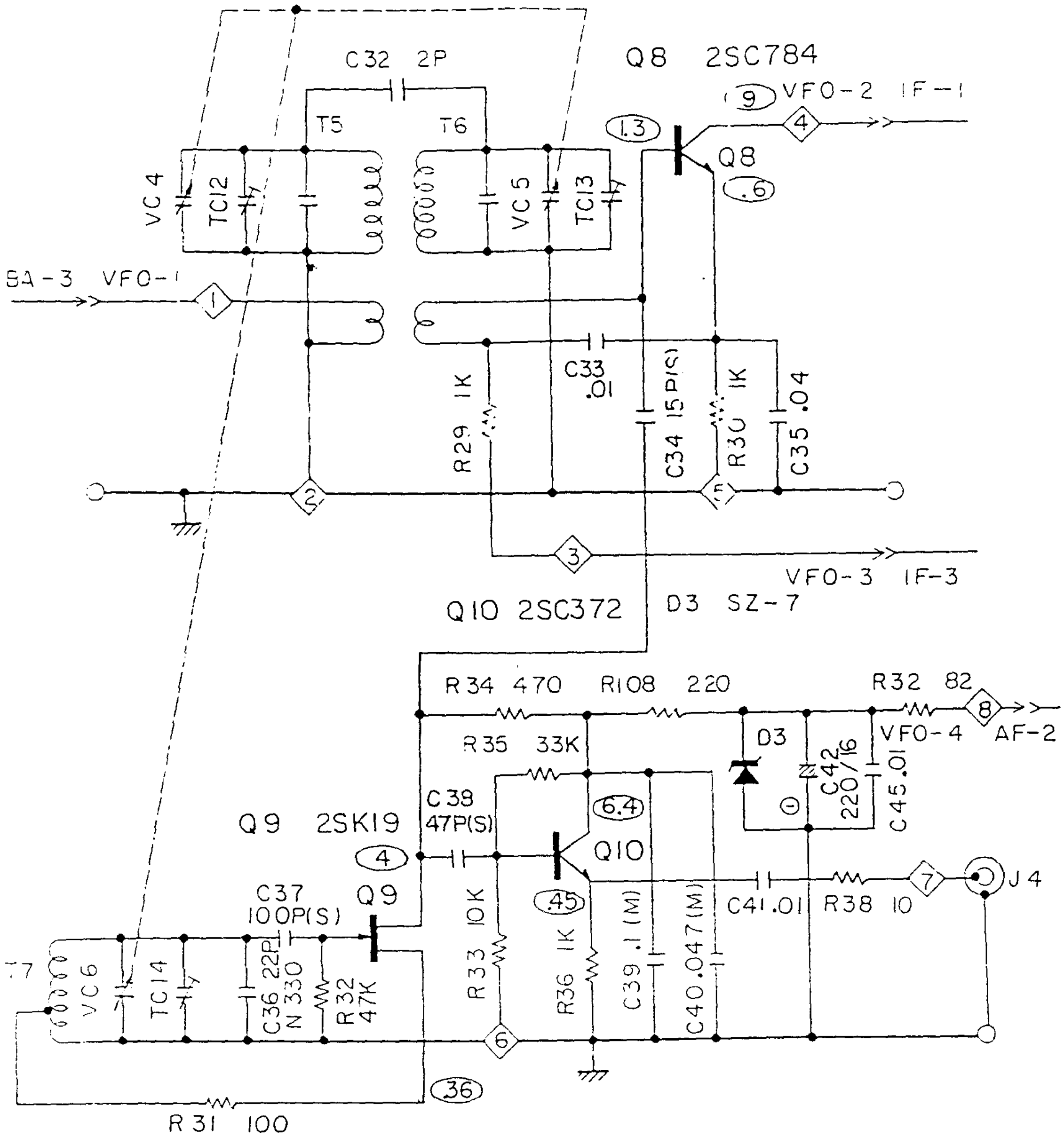


Fig. 14 VFO schematic diagram

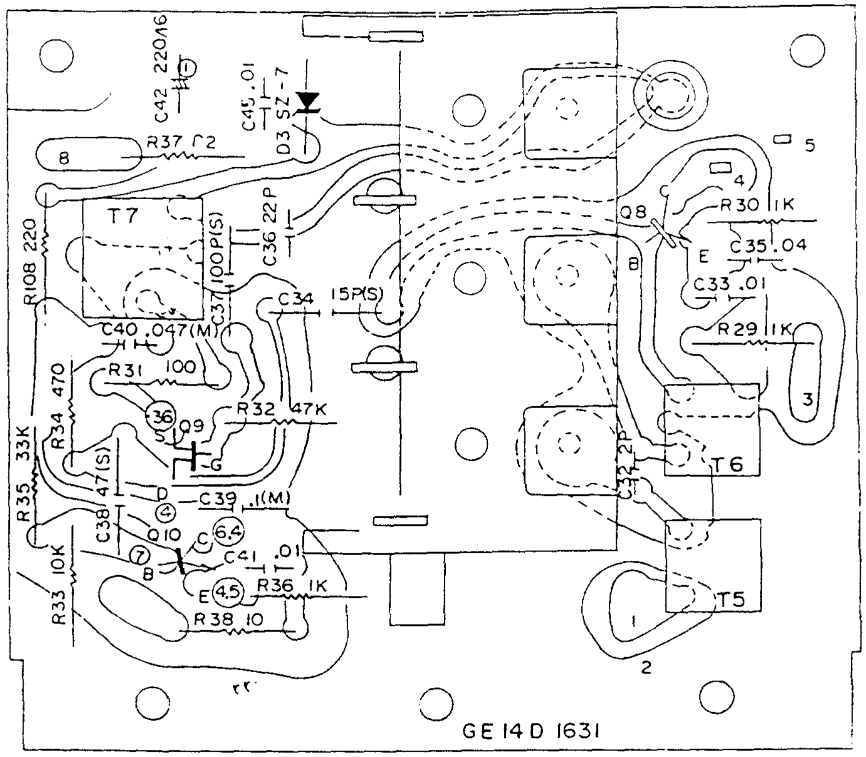


Fig. 15 VFO PCB top view

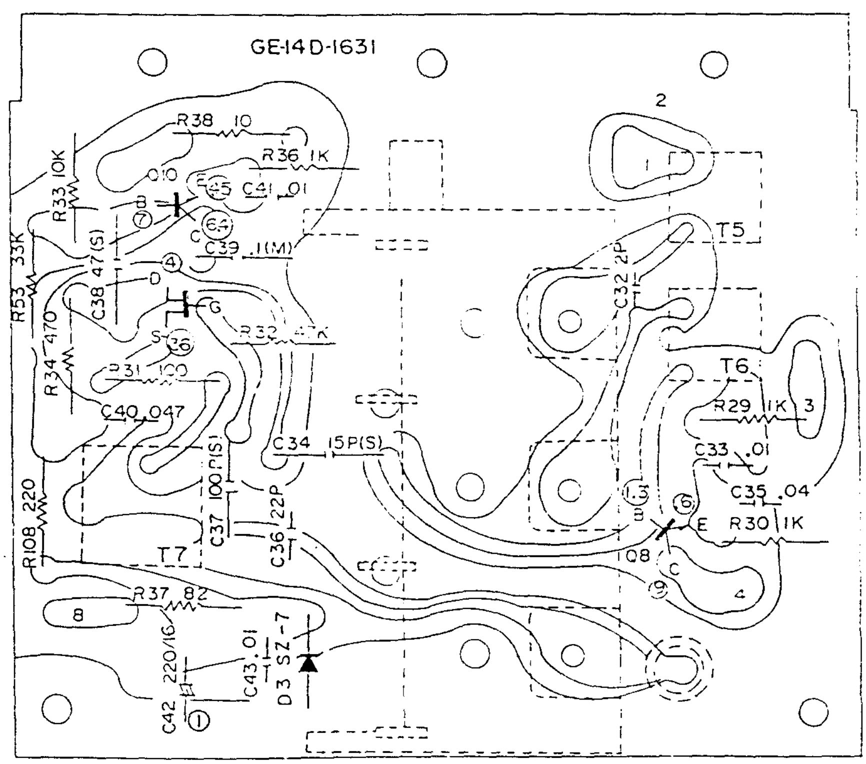


Fig. 16 VFO PCB rear view

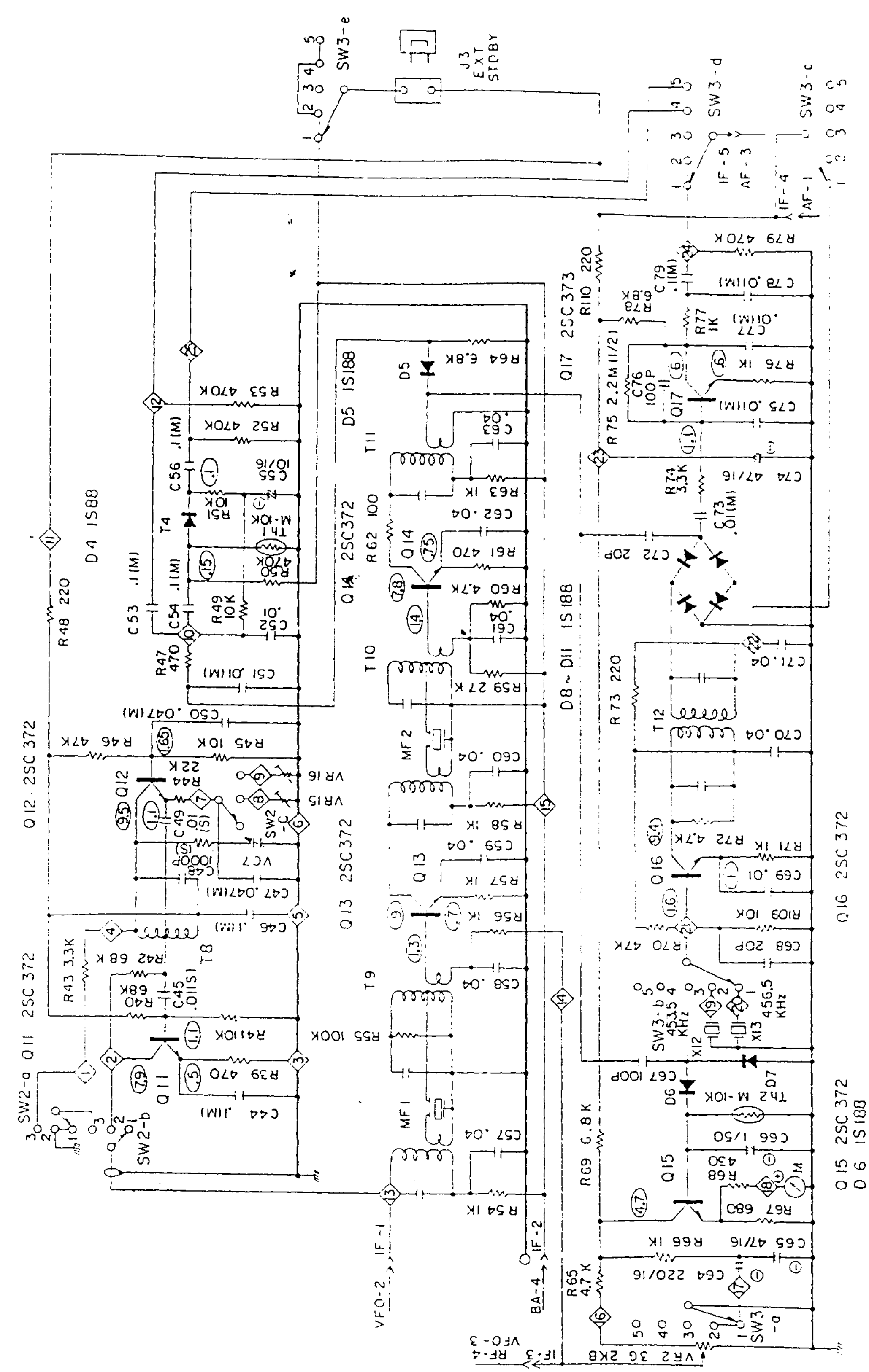


Fig. 17 IF schematic diagram

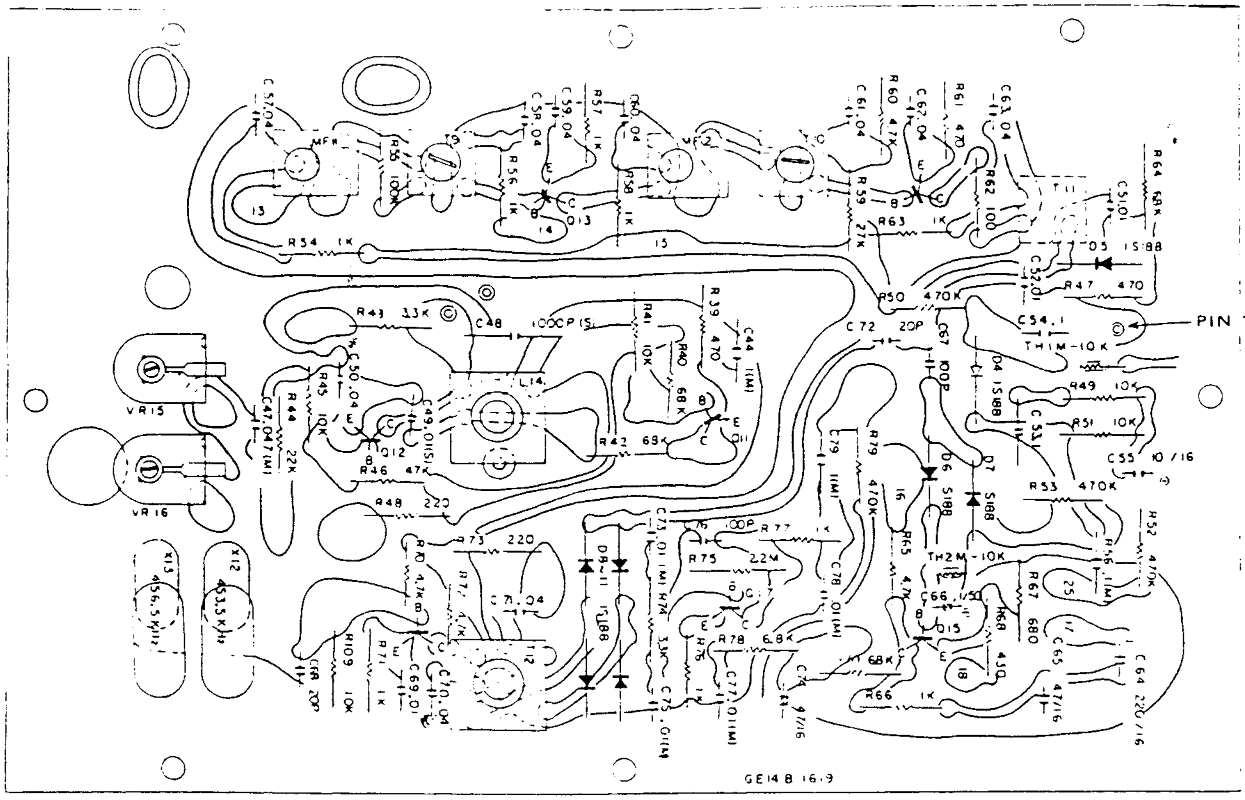


Fig. 18 IF PCB top view

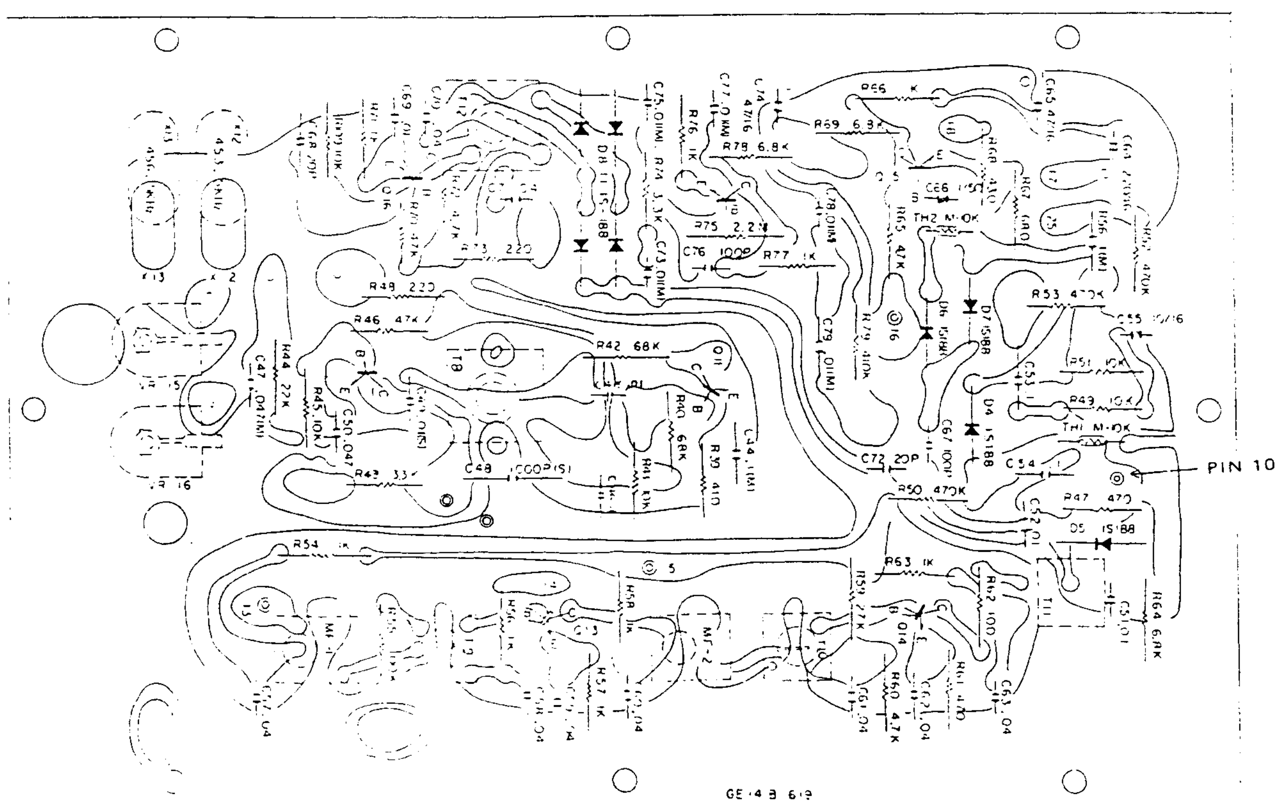


Fig. 19 IF PCB rear view

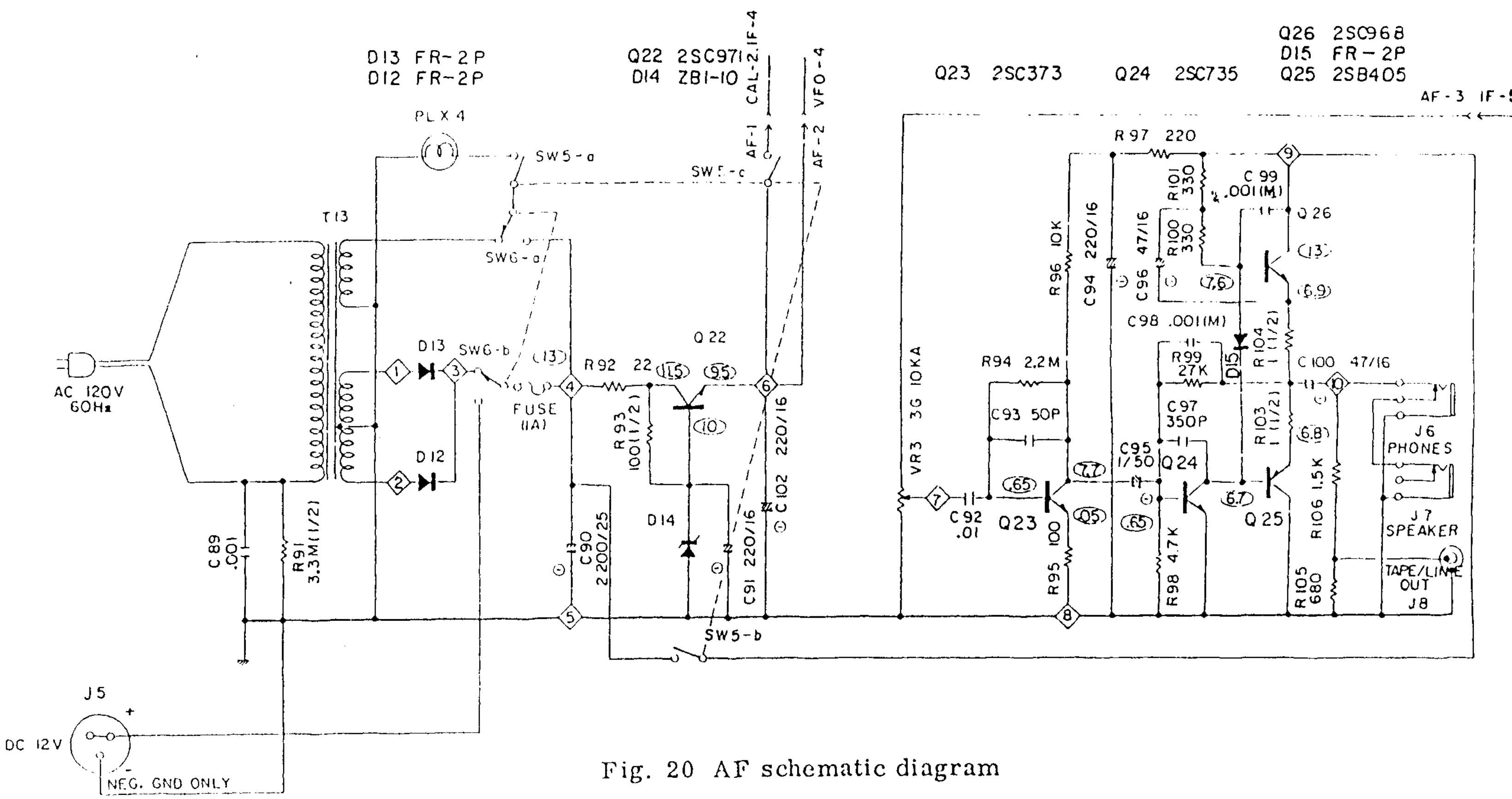


Fig. 20 AF schematic diagram

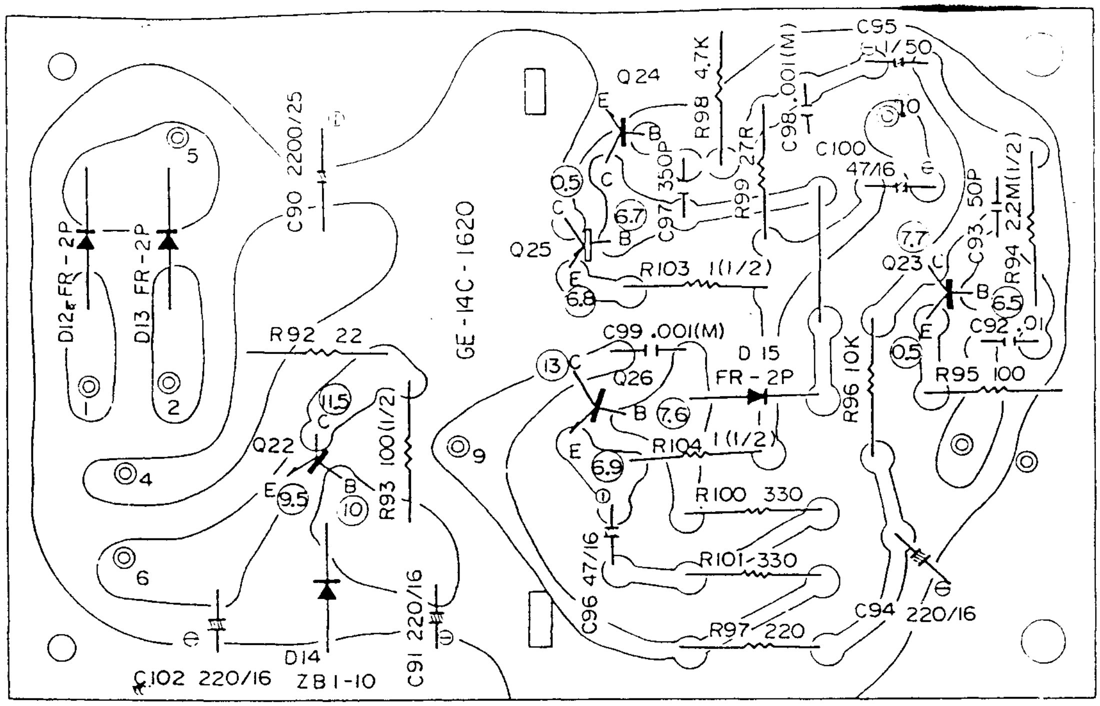


Fig. 21 AF PCB top view

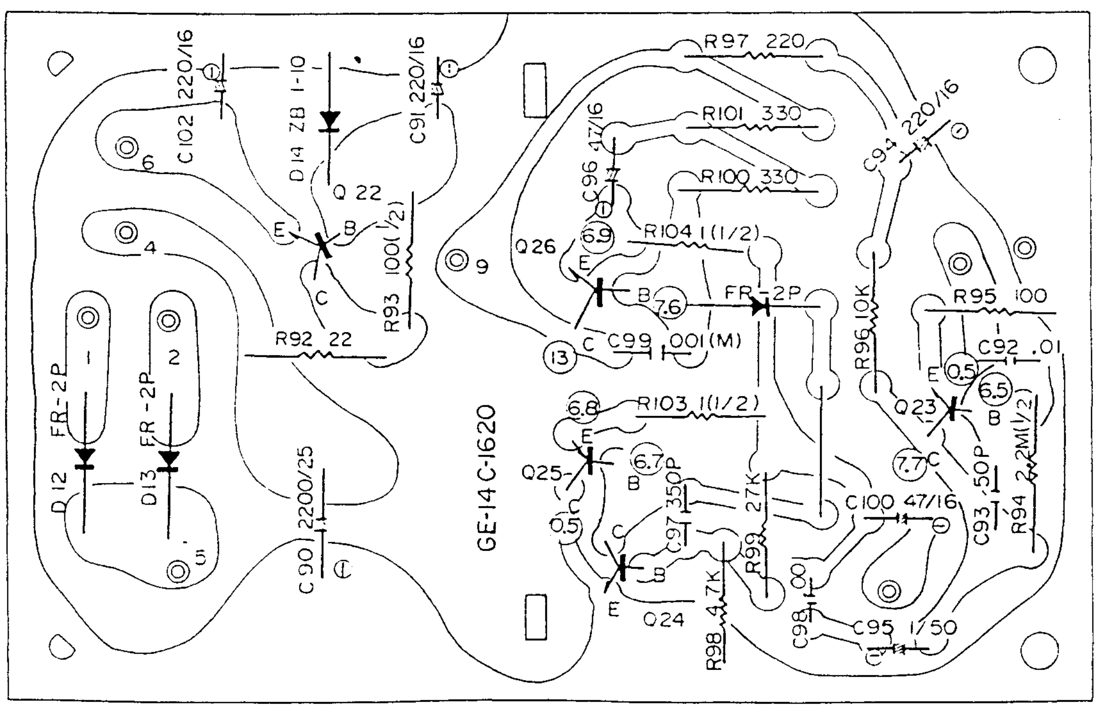


Fig. 22 AF PCB rear view

6. General schematic diagram

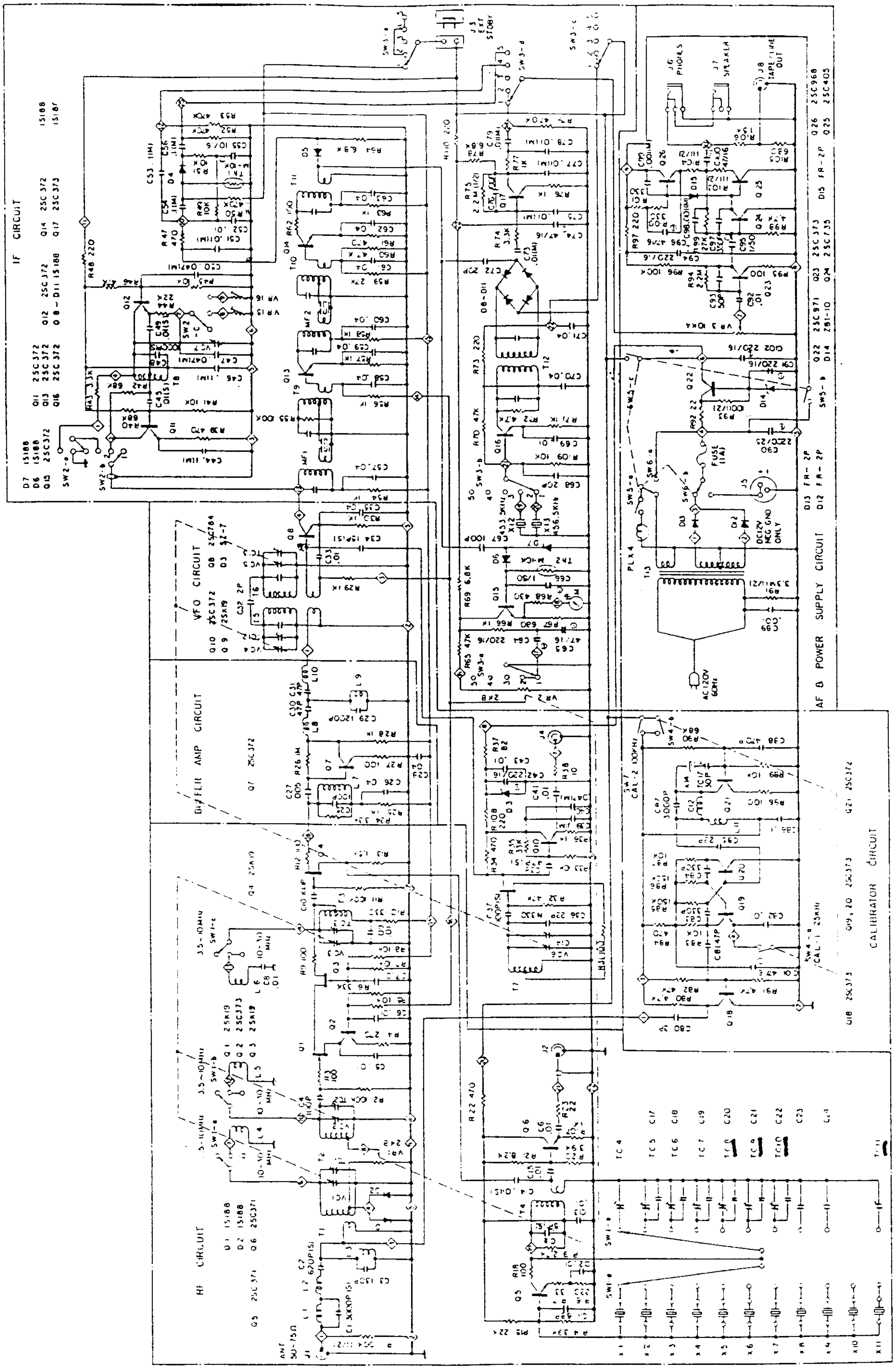


Fig. 23 General schematic diagram

5X190. ONLY.

7. PARTS LIST

SYMBOL NO.	DESCRIPTION	RATING OR STOCK NO.	REMARKS
Q1	FET	2 SK 19 (Y)	
Q2	Transistor	2 SC 373	
Q3, 4	FET	2 SK 19 (Y)	
Q5	Transistor	2 SC 371 (O)	
Q6	"	2 SC 371 (Y)	
Q7	"	2SC 372 (Y)	
Q8	"	2 SC 784 (O)	
Q9	FET	2 SK 19 (Y)	
Q10, 11, 12, 13 14, 15, 16	Transistor	2 SC 372 (Y)	
Q17, 18, 19, 20	Transistor	2 SC 373	
Q21	"	2 SC 372 (Y)	
Q22	"	2 SC 971 (C)	
Q23	"	2 SC 372 (Y)	
Q24	"	2 SC 735 (Y)	
Q25	"	2 SC 405	
Q26	"	2 SC 968 (C)	
D1, 2	DIODE	1S 188 FM	
D3	"	SZ-7±10%	
D4 - 11	"	1S 188 FM	
D12, 13	"	FR-2	
D14	"	ZB-1-10	
D15	"	FR-2	
TH1, 2	Thermister	M-10K	
R1	Fixed Resistor 1/2W	100 K ohm	
R2	" 1/4W	100 K ohm	
R3	"	100 ohm	
R4	"	270 ohm	
R5	"	10 K ohm	
R6	"	33 K ohm	
R7, 8	"	10 K ohm	
R9	"	100 ohm	
R10	"	330 ohm	
R11	"	100 K ohm	
R12	"	100 ohm	
R13	"	1.5 K ohm	
R14	"	3.9 K ohm	
R15	"	22 K ohm	
R16	"	220 ohm	
R17	"	33 ohm	
R18	"	100 ohm	
R19	"	2.7 K ohm	
R20	"	3.9 K ohm	
R21	"	8.2 K ohm	

SYMBOL NO.	DESCRIPTION	RATING OR STOCK NO.	REMARKS
R22	Fixed Resistor 1/4W	470 ohm	
R23	"	22 ohm	
R24	"	3.3 K ohm	
R25	"	1 K ohm	
R26	"	1 M ohm	
R27	"	100 ohm	
R28	"	1 K ohm	
R29	"	1 K ohm	
R30	"	1 K ohm	
R31	"	100 ohm	
R32	"	47 K ohm	
R33	"	10 K ohm	
R34	"	470 ohm	
R35	"	33 K ohm	
R36	"	1 K ohm	
R37	"	82 ohm	
R38	"	10 ohm	
R39	"	470 ohm	
R40	"	68 K ohm	
R41	"	10 K ohm	
R42	"	68 K ohm	
R43	"	3.3 K ohm	
R44	"	22 K ohm	
R45	"	10 K ohm	
R46	"	47 K ohm	
R47	"	470 ohm	
R48	"	220 ohm	
R49	"	10 K ohm	
R50	"	470 K ohm	
R51	"	10 K ohm	
R52, 53	"	470 K ohm	
R54	"	1 K ohm	
R55	"	100 K ohm	
R56	"	1 K ohm	
R57	"	1 K ohm	
R58	"	1 K ohm	
R59	"	27 K ohm	
R60	"	4.7 K ohm	
R61	"	470 ohm	
R62	"	100 ohm	
R63	"	1 K ohm	
R64	"	6.8 K ohm	
R65	"	4.7 K ohm	
R66	"	1 K ohm	
R67	"	680 ohm	
R68	"	430 ohm	

SYMBOL NO.	DESCRIPTION	RATING OR STOCK NO.	REMARKS
R69	Fixed Resistor 1/4W	6.8 K ohm	
R70	"	47 K ohm	
R71	"	1 K ohm	
R72	"	4.7 K ohm	
R73	"	220 ohm	
R74	"	3.3 K ohm	
R75	" 1/2W	2.2 M ohm	
R76	" 1/4W	1 K ohm	
R77	"	1 K ohm	
R78	"	6.8 K ohm	
R79	"	470 K ohm	
R80	"	4.7 K ohm	
R81	"	4.7 K ohm	
R82	"	47 K ohm	
R83	"	10 K ohm	
R84	"	470 ohm	
R85	"	150 K ohm	
R86	Fixed Resistor 1/4W	150 K ohm	
R87	"	10 K ohm	
R88	"	100 ohm	
R89	"	10 K ohm	
R90	"	68 K ohm	
R91	" 1/2W	3.3 M ohm	
R92	" 1/4W	22 ohm	
R93	" 1/2W	100 ohm	
R94	"	2.2 M ohm	
R95	" 1/4W	100 ohm	
R96	"	10 K ohm	
R97	"	220 ohm	
R98	"	4.7 K ohm	
R99	"	27 K ohm	
R100	"	330 ohm	
R101	"	330 ohm	
R103	" 1/2W	4.7 ohm	
R104	"	4.7 ohm	
R105	" 1/4W	680 ohm	
R106	"	1.5 K ohm	
R107	"	1 K ohm	
C1	Styrol capacitor	3000PF	SOA-III-302J
C2	"	620PF	SOC-III-621J
C3	"	130PF	SOC-III-131J
C4	Styrol or Disc ceramic	100PF	SOA-III-101J or FCC 100PF
C5	Disc ceramic	.01MF	MMC-50 .01
C6 - C9	"	.01MF	MMC-50 .01

SYMBOL NO.	DESCRIPTION	RATING OR STOCK NO.	REMARKS
C10	Styrol or Disc ceramic	100PF	SOA-III-101J or FCC 100PF
C11	"	68PF	SOA-III-680J or FCC 68PF
C12, 13	Disc ceramic	.01MF	MMC-50 .01
C14	"	.01MF	"
C15	Styrol capacitor	.01MF	SOC-III-103J
C16	Disc ceramic	.01MF	MMC-50 .01
C17	Styrol capacitor	510PF [3.5]	For AX-190
C18	Styrol or Disc ceramic	150PF [7]	"
C19	"	47PF [44]	"
C20	"	68PF [15]	"
C21	"	47PF [21]	"
C22	"	10PF [27]	"
C17	Styrol capacitor	510PF [3.5]	For SX-190
C18	"	250PF [5.7]	"
C19	Styrol or Disc ceramic	220PF [7.0]	"
C20	"	100PF [9.5]	"
C21	"	68PF [11.5]	"
C22	"	47PF [14]	"
C23	"	68PF [15]	"
C24	"	57PF [17.5]	"
C25		100PF	with in L7
C26	Disc ceramic	.04MF	MMC-90 .04
C27	"	0.05MF	MMC-50 .005
C28	"	.04MF	MMC-90 .04
C29	Styrol capacitor	1200PF	SOC-III-122J
C30	"	47PF	with in L8
C31	"	47PF	with in L10
C32	Disc ceramic	2PF	FC-50 2P (M)
C33	"	.01MF	MMC-50 .01
C34	Styrol capacitor	15PF	SOA-III-150M
C35	Disc ceramic	.04MF	MMC-90 .04
C36	"	22PF	FCS-60 marked GRN
C37	Styrol capacitor	100PF	SOA-III-101J
C38	"	47PF	SOA-III-470K
C39	Mylar capacitor	.1MF	
C40	"	.047MF	
C41	Disc ceramic	.01MF	MMC-50 .01
C42	Electrlytic	220MF 16WV	CE-04WIC 220
C43	Disc ceramic	.01MF	MMC-50 .01
C44	Mylar capacitor	.1MF	
C45	Styrol capacitor	.01MF	SOC-III-103J
C46	Mylar capacitor	.1MF	
C47	"	.047MF	

SYMBOL NO.	DESCRIPTION	RATING OR STOCK NO.	REMARKS
C48	Styrol capacitor	1000PF	SOA-III-102J
C49	"	.01MF	SOA-III-103J
C50	Mylar capacitor	.047MF	
C51	Disc ceramic	.02MF	MMC-50 .02
C52	"	.02MF	MMC-50 .02
C53	Mylar capacitor	.1MF	
C54	"	.1MF	
C55	Electrolytic	10MF 16WV	CE-04WIC 100
C56	Mylar capacitor	.1MF	
C57 - 63	Disc ceramic	.04MF	MMC-90 .04
C64	Electrolytic	220MF 16WV	CE-04WIC 220
C65	"	47MF 16WV	CE-04WIC 470
C66	"	1MF 50WV	CE-04WHI 010
C67	Disc ceramic	100PF	FC-70 100P (M)
C68	"	20PF	FC-50 20P (M)
C69	"	.01MF	MMC-50 .01
C70 - 71	"	.04MF	MMC-90 .04
C72	"	20PF	FC-50 20P (M)
C73	Mylar capacitor	.01MF	
C74	Electrolytic	47MF 16WV	CE-04WIC 470
C75	Mylar capacitor	.01MF	
C76	Disc ceramic	100PF	FC-70 100P (M)
C77	Mylar capacitor	.01MF	
C78	Mylar capacitor	.01MF	
C79	"	.1MF	
C80	Disc ceramic	3PF	FC-50 3P (M)
C81	Styrol capacitor	47PF	SOA-III 470K
C82	Disc ceramic	.01MF	MMC-50 .01
C83, 84	Styrol capacitor	330PF	SOC-III-331J
C85	"	22PF	SOA-III-220M
C86	Disc ceramic	.1MF	MMC-135 .1
C87	"	3000PF	SOA-III 302J
C88	"	470PF	SOC-III-471J
C89	Oil capacitor	0.001 600WV	UL
VC1,2,3	Variable capacitor	C635AII9	
VC4,5,6	"	C532CII5	
VC6	"	100PF	
TC1,2,3	Trimmer capacitor		with VC1,2,3
TC4	"	30P BIM-2	
TC5	"	200P B2M	
TC6	"	100P B4M	
TC7	"	30P BIM-2	
TC8	"	30P BIM-2	only with SX-190
TC9	"	30P BIM-2	"
TC10	"	30P BIM-2	"
TC11	"	30P BIM-2	"

SYMBOL NO.	DESCRIPTION	RATING OR STOCK NO.	REMARKS
TC12	Trimmer capacitor	ATI-7	on the VC4
TC13	"	ATI-7	" VC5
TC14	"	ATI-6	
TC17	"	30P BIM-2	
T1,2,3	3.5-10 MHz ANT/RF coil	R2970	
T4	HFO Coil	R2910	
T5, 6	1st IF Coil	R2906	
T7	VFO Coil	V6AQN2007FBU	
T8	Q-Multiplier	HY80H2B	
T9, 10	455 KHz IF	R2907 (YEL)	
T11	"	R8579C (BLK)	
T12	BFO Coil	R2925	
T13	Power Transformer	Y0135	
L1	2.920 MHz Trap	R2910	
L2	LPF	R2912	
L3	HPF	R2911	
L4, 5, 6	10-30 MHz ANT/RF	R2908	
L7	Buffer Amp	R2904	
L8	"	R2909	
L9	"	R2905	
L10	"	R2909	
L11	2 mH	9LNC-009	
L12	250 μ H	4LNC-025	
MF1	Mechanical Filter	MFH-40K	
MF2	"	"	
PCB	RF	GE-14B-1624	
	Buffer Amp	GE-14D-1661	
	VFO	GE-14D-1631	
	IF	GE-14B-1618	
	AF	GE-14C-1620	
	CAL	GE-14D-1621	
Xtal	HC 25/U	6.420 MHz	For 3.5 MHz Band
	"	8.620 MHz	For 5.7 MHz Band
	"	9.920 MHz	For 7.0 MHz Band
	"	12.420 MHz	For 9.5 MHz Band
	"	14.420 MHz	For 11.5 MHz Band
	"	16.920 MHz	For 14.0 MHz Band
	"	17.920 MHz	For 15.0 MHz Band
	"	20.420 MHz	For 17.5 MHz Band
	"	23.920 MHz	For 21.0 MHz Band
	"	29.920 MHz	For 27.0 MHz Band
	"	30.920 MHz	For 28.0 MHz Band
	"	31.420 MHz	For 28.5 MHz Band
	"	31.920 MHz	For 29.0 MHz Band
	"	32.420 MHz	For 29.5 MHz Band

SYMBOL NO.	DESCRIPTION	RATING OR STOCK NO.	REMARKS
	HC 6/U	456.5 KHz	
	"	453.5 KHz	
	HC 13/U	100 KHz	
	Xtal socket	SD-0105	
	Fuse Holder	SN-1301	(UL)
	Coupling	SX-3501	
SW1	Rotary switch	Y5511 3801466	SX-190
		" 3801465	AX-190
SW2	"	F365	
SW3	"	F133	
SW4	CAL SW	2FS-4 -17B	
SW5	Power SW	1FS-4 - 7B	
SW6	AC/DC SW	6P9L	
VR 1, 2, 3	RF/AF Volume	2KBX2 10KA JF40A	
VR 15, 16	Semifixed Volume	50K ohm B	
J1	Ant jack	UHF R-3	
J2	HFO Out jack	15D-2066	#19406
J3	EXT STDBY jack	No 3822	
J4, 8	VFO/TAPE Out jack	#9203	
J5	DC jack	No 1476 3P	
J6, 7	Phone jack	SG-7615	
	Fuse	1A-125V	
	Station	1L 2P	
	Feet	#7109	
	"	#2192	additional one
	Pilot lamp	14V 80mA	310 L
	"	"	220 L
	"	"	190 L
	S-meter	S10 200 μA	
	AC cord	6 feet	UL
	Cord Strain Relief	3P-4	Heyco
	Pully	40 φ	
	Spring	25 L	
	Knob		
	Main dial	GE-15D-1674A	
	Control W/mark	GE-15D-1911	
	" WO/mark	GE-15D-1911A	
	Band SW	GE-15D-2061	
	Function SW	GE-15D-2061	
	AF/RF	GE-15D-1912-1	
		GE-15D-1912-2	
	Preselector shaft	GE-15D-2214	
	Preselector dial	GE-15D-2565	For AX-190 or SX-190
	Main dial	GE-15D-1676	

SYMBOL NO.	DESCRIPTION	RATING OR STOCK NO.	REMARKS
	T Panel Assembly	GE-15A-2053	
	Spread dial	GE-15D-2043	
	Front Panel	GE-15B-2047	For AX-190 or SX-190
	Flame	GE-15B-2169	
	Shassis	GE-15A-2063	
	Back Plate Right	GE-15B-2167	
	" Left	GE-15B-2168	
	Cabinet Upper	GE-15B-2166	
	" Lower	GE-15B-2165	
	Main dial pointer	GE-15D-2213	
	Preselector pointer	GE-15D-2212	
	VFO Box	GE-15B-1665	
	VFO Box cover Upper	GE-15D-1666	
	" Lower	GE-15D-1667	
	Buffer Amp Case	GE-15D-2000	
	Heat sink saddle	GE-13A-972	
	" plate	GE-15D-2209	
	3G VC Bracket	GE-15D-1667	
	" shield plate	GE-15D-2208	
	Preselector cover	GE-15D-2211	
	Pilot lamp mount bracket	GE-15D-2210	
	Gear	GE-15D-2198	
	PCB Stud	GE-15D-2175	
	Sleeve for main dial	GE-15D-2115	
	Sleeve for preselector	GE-HC-617	
	Fiber cover		
	Caution label		
	Model label		

8. Trouble shooting

Dificulty	Possible cause and check point
Completly does not work	a. Blow lA fuse b. Faulty silicon diode D13, D14 c. Faulty power transformer T13 d. Faulty AC/DC switch e. Check the supply voltage f. Check the AF circuit
Completly does not work but remained little noise or hum.	a. Defective Q22 2SC971 b. Check the VFO c. Check the HFO d. Check each supply voltage
Extremely low sensitivity all Bands	a. Check each transister voltage of IF PCB b. Check each transister voltage of lst IF circuit (Buffer amp and variable IF circuit) c. Check each transister voltage of RF PCB
10-30 MHz Band does not work but 3.5-10 MHz works	a. Faulty L4, L5 or L6 b. Faulty band switch
10-30 MHz Band does not work and also 3.5-10 MHz too	a. Faulty Tl, T2 or T3 b. Faulty band switch
3.5-10 MHz Band does not work but 10-30 MHz Band works	a. Faulty Tl, T2 or T3 b. Faulty band switch
One or two Band does not work	a. Faulty one or two crystal of lst local oscillator b. Faulty capacitor C17-C24 or TC4-TC11 c. Faulty band switch
Does not work Rejection and Selection	a. Check the voltage of Q12 b. Faulty Q12 c. Faulty T8 d. Faulty Q-Multi SW
Does not work Selection	a. Faulty VR16 b. Faulty Q-Multi SW
Does not work Rejection	a. Check the voltage of Q11 b. Faulty VR15 c. Faulty Q-Multi SW

Dificulty	Possible cause and check point
Both 100 KHz/25 KHz CAL does not work	a. Check the voltage of Q21 b. Faulty Q21 c. Faulty L11 or 12 d. Faulty Xtal
25 KHz CAL does not work	a. Check the voltage of Q19 & 20 b. Faulty Q19 or 20 c. Faulty C83, C84 or C85
No USB or LSB	a. Check the voltage of Q16 b. Faulty Q16 c. Faulty T12 d. Faulty X12 or X13 e. Faulty Function SW
Sound distorted on AM	a. Check the voltage of Q23, 24, 25 and 26 b. Faulty one or tyo of them
BFO works but sound distorted on SSB	a. Check the voltage of Q17 b. Faulty Q17 c. Faulty D8, 9, 10 or 10
No HFO output	a. Check the voltage of Q6 b. Faulty Q6 c. Faulty output jack J2
No VFO output	a. Check the voltage of Q10 b. Faulty Q10 c. Faulty output jack J4
Too mach frequency drift	a. Check the supply voltage to Q9 and 10 b. Faulty Q22, D14 or D3
S-meter does not work even strong signals	a. Check the voltage of Q15 b. Faulty Q15 c. Faulty D6 or 7 d. Faulty S-meter

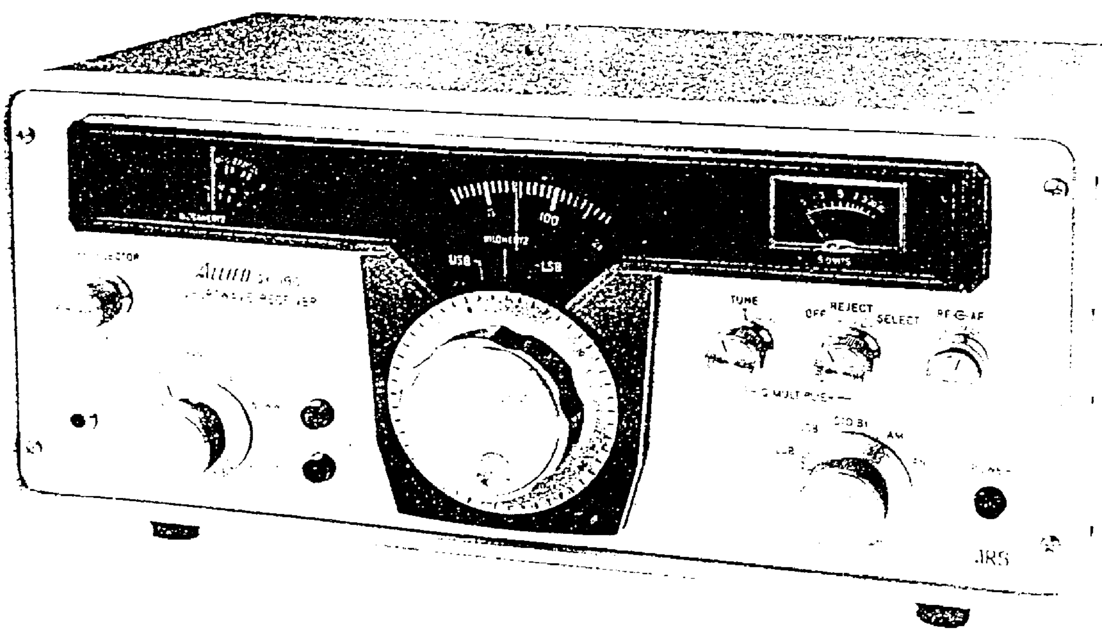
INSTRUCTION MANUAL

ALLIED®

SX-190

SOLID STATE

11 BAND SHORTWAVE RECEIVER



CAT. NO. 2

CUSTOM MANUFACTURED FOR

ALLIED RADIO SHACK A TANDY CORPORATION COMPANY

TECHNICAL SPECIFICATION

Basic Frequency Coverage
*Additional Band .... 500 KHz band width
*Crystal not supplied.. 3.5 to 10 MHz
80 meter Band .... 3.5 to 4.0 MHz
49 meter Band .... 5.7 to 6.2 MHz
40 meter Band (HAM) .... 7.0 to 7.5 MHz
31 meter Band (WWV@ 10 MHz).................................. 9.5 to 10.0 MHz
25 meter Band .... 11.5 to 12.0 MHz
20 meter Band (HAM) .... 14.0 to 14.5 MHz
19 meter Band (WWV@15 MHz).................................. 15.0 to 15.5 MHz
16 meter Band .... 17.5 to 18.0 MHz
11 meter Band (CB) .... 27.0 to 27.5 MHz
*Crystal not supplied.. 10.0 to 30.0 MHz
Number of semiconductors.... 4 FET, 22 TR, 13 diodes, 2 zeners and 2 thermisters
IF. Frequencies...................... 2.420 MHz to 2.920 MHz (Variable) and 455 KHz
Reception .... AM, CW, and Single sideband (SSB)
Sensitivity - AM.................... Less than 1 microvolt for 10 db S/N ratio
Sensitivity SSB/CW .... Less than 0.5 microvolt for 10 db S/N ratio
Selectivity.............................. 4 KHz at 6 db down
Visual dial accuracy .... ±200 Hz
Calibration accuracy............. Better than ±500 Hz adjacent 25 KHz calibration points after indexing
Stability .... Better than 500 Hz after warm-up
Image rejection...................... More than 60 db
Spurious rejection.................. More than 50 db
Rejection tuning .... More than 40 db
Selection tuning..................... 500 Hz at -3db
Audio output power............... Maximum 1 watt at 8-ohm load
Audio output impedance........ 8 ohm and 600 ohm
Headphone output .... 8 ohm, panel-mounted jack accepts standard 1/4-inch plug
Antenna input impedance...... 50 ohm to 75 ohm unbalanced: rear mounted type SO-239 coaxial receptacle accepts PL-259 connector
Power source .... 120 volt AC 60 Hz and 12V DC negative ground only
Power consumption .... 10 watts
Remote stdby control............. Rear-mounted; 2 pin connector
Dimensions............................ 7" high, 15" wide and 10" deep

GENERAL DESCRIPTION

The SX-190 SHORTWAVE RECEIVER is fully transistorized and offers a new high in reliability, selectivity, and drift free operation. It covers the 49 thru 16-meter international broadcasting bands plus the 11-meter CB band and WWV at 10 and 15 MHz. Two blank positions are left for the owner who may by the addition of the proper crystal, cover any 500 KHz wide segment of frequency between 3.5 thru 10 MHz and 10.0 thru 30.0 MHz. These bands are selectable with the front panel band selector switch.

Its circuitry uses 4 FETS, 22 transistors, 13 diodes, 2 thermistors and 2 zener regulators. Dual conversion and mechanical filters enhance the excellent image and spurious rejection plus sharp selectivity of this receiver.

The suppression of unwanted heterodynes and interfering carriers is enhanced by the Q-MULTIPLIER, which provides better than 40 dB of attenuation.

The use of a PRESELECTOR assures maximum sensitivity and a high signal to noise ratio for outstanding reception of weak signals. The tuning dial features anti-backlash construction. It is direct reading to 1 KHz. Precise tuning of all signals including SSB is assured by the large easy to read dial. Superior stability is obtained by the use of a crystal controlled 1st local oscillator and a VFO 2nd oscillator. A dual frequency calibrator (25 and 100 KHz), crystal controlled, is used for calibrating the dial readout to an accuracy of better than ±200Hz.

The SX-190 is equipped with a crystal controlled Beat Frequency Oscillator (BFO) for the reception of USB, LSB and CW signals.

Incorporated in its circuitry are AGC, ANL and S-meter functions. The AGC (Automatic Gain Control) has been tailored to produce minimum audio output changes even with large variations of input signal levels. ANL (Automatic Noise Limiter) operation is achieved through the use of a diode. When pulse type interference accompanies an incoming signal, the diode in the ANL circuit operates in a cutoff mode for very brief time intervals, thus it effectively acts as a gate to shut out undesirable noise peaks. The S-METER indicates incoming signal strength and also acts as a tuning aid by indicating peak signal.

A dual power supply operates from a source of 110-120 volts 60 Hz AC or 12 volts DC. On AC, a 1-ampere fuse in the secondary of the power transformer is used for protection of the equipment. The B+ power supply uses a full wave rectifier and a stabilized regulator.

The antenna input is designed to operate with a wide variety of 50-75 ohm antennas. Both speaker and headphone jacks are provided (8 ohm). For use with a companion transmitter, muting connections are available at the rear panel along with both HFO and VFO outputs.

Rugged mechanical construction plus modularized design provide for maximum mechanical stability and ready access to either the top or bottom of the SX-190. This allows for maximum ease of maintenance or alignment should either become necessary.

SECTION 1: INSTALLATION

1.1 UNPACKING

Immediately after receipt of the receiver it should be removed from the shipping carton and visually inspected to insure that it has not been damaged in shipment. If it is determined that the receiver has been damaged in transit the shipping carton and packing material should be saved and the transportation company notified immediately.

As part of the initial inspection, all of the front panel controls should be checked to insure their proper mechanical operation. It is advisable to generally, look the receiver over and verify that nothing has been shaken loose and that everything appears to be normal.

The following items are supplied with each receiver:

1. Instruction manual, ALLIED MODEL SX-190.

2. DC power cable assembly.

3. 1/4" phone plug connector.

4. Additional feet.

1.2 RECEIVER CONNECTIONS

If the SX-190 Receiver is to be used for receiving only and not as part of a system with interconnections to an associated transmitter there are only a few required connections. These connections are easily accessible at the rear of the receiver and their design permits permanent connections to be made in a neat manner. Figure 1-2 (page 5) illustrates the connections points at the rear of the receiver.

1.2.1 ANTENNA CONNECTION

The SX-190 Receiver has been designed to operate from a 50-75 ohm unbalanced antenna input. To obtain the best results from the receiver the antenna that most nearly suits your needs should be selected. The illustrations shown in Figure 1-5 (page 7) are typical antenna installations. All that is required is to install a PL-259 connector on the feed line and connect it to the antenna input.

1.2.2 SPEAKER CONNECTIONS

Instructions for installing the phones plug on the speaker cable are illustrated in Figure 1-3 (page 6). After wiring the connector, insert in Phones/SPK jack.

1.2.3 GROUND CONNECTIONS and/or LIGHTNING ARRESTOR INSTALLATION

A good external earth ground connection to the chassis is a must to eliminate a potential shock hazard. It is possible that a voltage may exist between the chassis and ground as a result of the power line bypass capacitor that is connected between chassis and the power line. A method of connecting a ground is illustrated in Figure 1-4 (page 6).

As added protection it is also desirable to install a lightning arrestor. This would provide protection for the receiver as well as the operator. Figure 1-5 (page 7) illustrates the method of installing lightning arrestors.

1.2.4 POWER CONNECTIONS

Before inserting the power cable it should first be determined that the power source is of the proper voltage and frequency. For use on 12 VDC insert the plug which is part of the DC power cable into DC jack and connect the red cable to positive side, the black to negative. It is important to observe the polarity when using the receiver on 12 VDC.

1.2.5 STD BY CONNECTIONS

The STD BY jack is jumpered in factory to operate the receiver.

1.3 INTERCONNECTIONS FOR USE WITH TRANSMITTER

Figure 1-1 (page 5) illustrates the interconnections required for using SX-190 Receiver with a transmitter.

The following paragraphs describe the required interconnections to use the receiver in this manner. The receiver and transmitter require a common ground and the antenna input to the receiver may be controlled by an internal antenna changeover relay in the transmitter or an external antenna changeover relay. Consult your transmitter manual for interconnection instructions.

1.3.1 STB BY CONNECTIONS

In order to mute the receiver internally, the function switch should be placed in STD BY. All other positions of the function switch allow the transmitter to control the muting of the receiver when interconnected properly. Remove the jumper wire from STD BY plug and connect to the relay in the transmitter. Consult your transmitter manual for interconnection instructions.

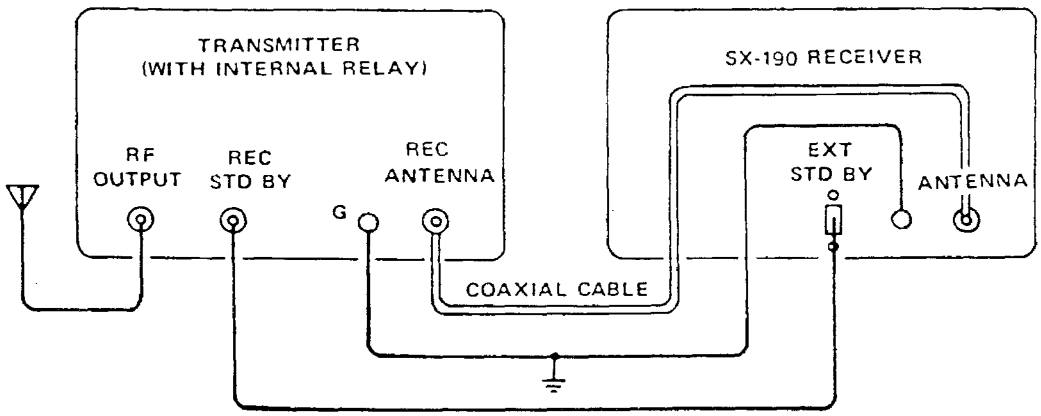
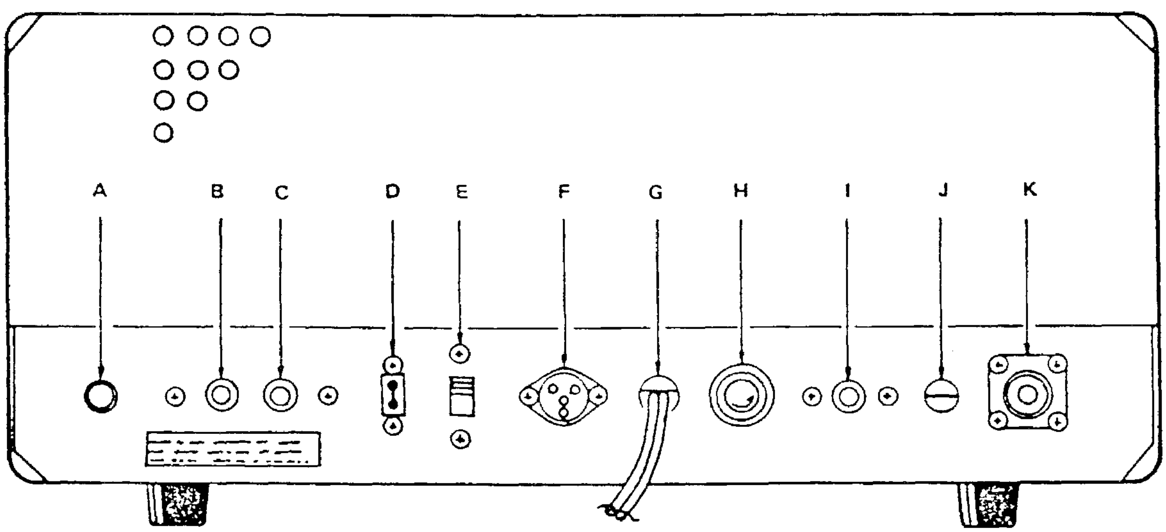


FIGURE 1-1 INTERCONNECTIONS



A - Speaker jack
B - Line/Tape output
C - VFO output
D - Ext std-by
E - AC/DC switch
F - DC input jack
G - AC line cord
H - Fuse
I - HFO output
J - GND terminal
K - 80-239 antenna jack

FIGURE 1-2 REAR VIEW OF SX-190

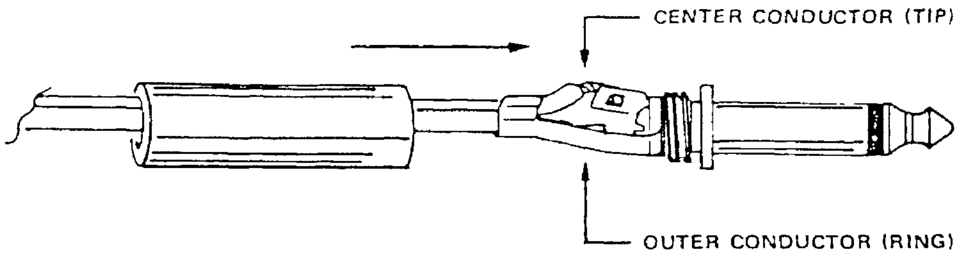


FIGURE 1-3 ATTACHING CABLE TO PHONE PLUG CONNECTOR

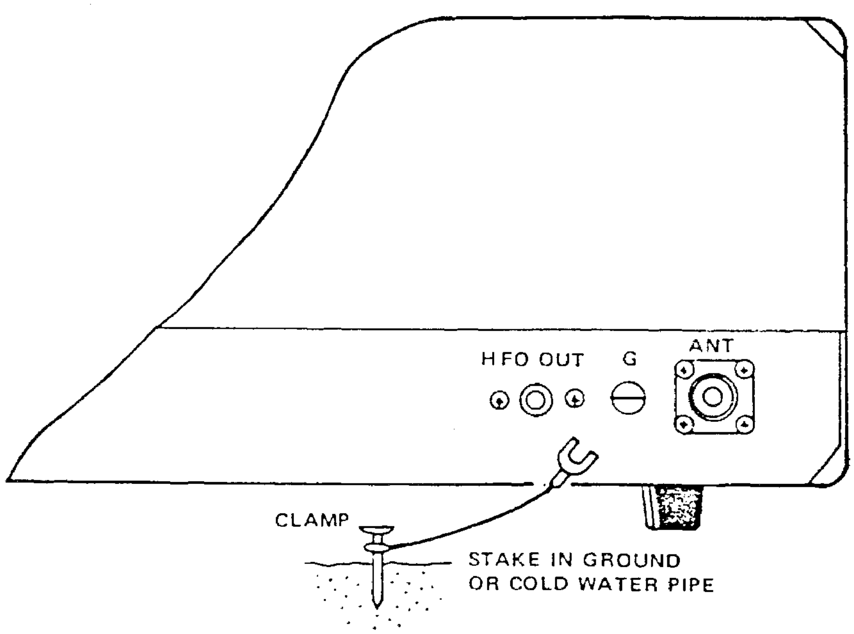


FIGURE 1-4 INSTALLATION OF GROUND

ANTENNAS

(a) Single Wire Antenna

The single wire or inverted "L" type of antenna will provide satisfactory performance over the entire tuning range. Simply connect one end of the antenna wire to center pin of a PL-259 Connector and attach to Antenna Jack. For good reception the antenna wire should he 30 to 100 feet long and placed as high as possible (see Fig. 1-5-1). Generally, this type of antenna provides maximum pick-up at right angles to its entire length. This should be borne in mind when installing the antenna. In some locations, reception may be improved by connecting a ground wire from the GND terminal to a cold water-pipe or outside ground rod. For protection against lightning, a lightning arrestor should be included in any outdoor antenna system.

(b) Doublet Antenna

A doublet antenna will give excellent results, especially on amateur bands. A 75 ohms balanced transmission line should be used (as shown in Fig. 1-5-2). Since the doublet antenna provides optimum performance only at a given frequency, it should be cut to the length for the most often used band of frequencies. The overall length of a doublet antenna can be determined by using the following formula:

$$L \text{ (Length in feet)} = \frac{468}{\text{Frequency MHz}}$$

Since the doublet antenna displays directional properties broadside to its length, it should be oriented in such a manner that maximum signal pickup can be realized.

(c) Other Antenna Systems

More elaborate antenna systems may be installed to provide better performance. Information on a number of different types can be obtained by referring to the Radio Amateur's Handbook or the A.R.R.L. Antenna Book, both published by the American Radio Relay League, West Hartford, Conn.

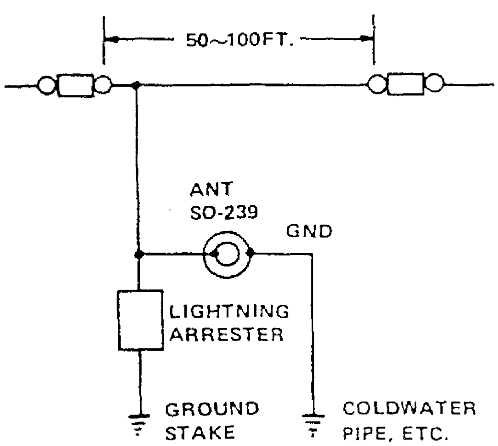


Figure 1-5-1

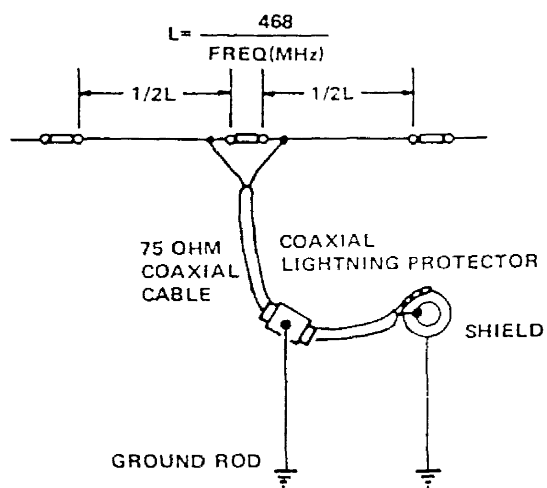
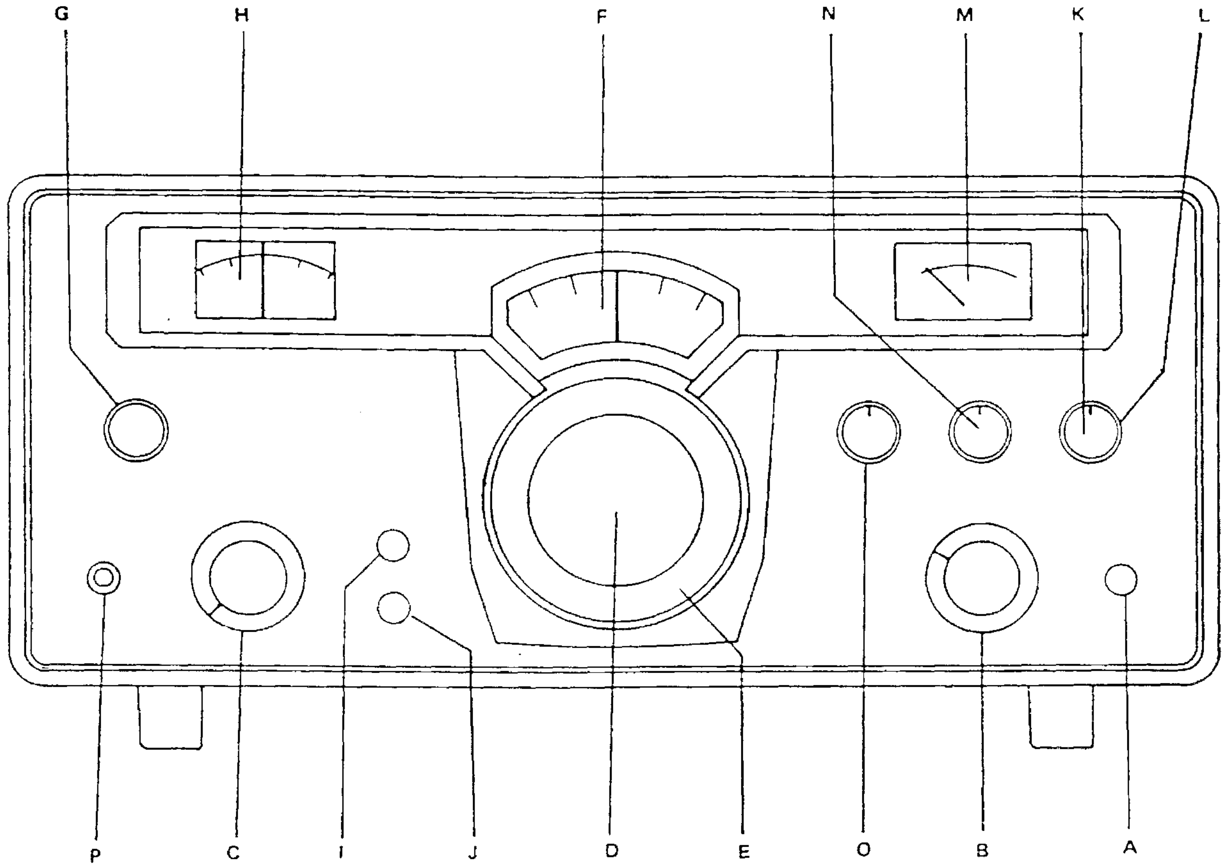


Figure 1-5-2

FIGURE 1-5 TYPICAL ANTENNA INSTALLATION



A - Power switch	I - 25 kHz Calibrator switch
B - Function switch	J - 100 kHz Calibrator switch
C - Band switch	K - AF gain control
D - Main tuning knob	L - RF gain control
E - Dial skirt	M - "S" meter
F - Main dial	N - Q-multiplier switch
G - Preselector	O - Rejection tuning
H - Preselector dial	P - Phones jack

FIGURE 2-1 FRONT VIEW OF SX-190

SECTION 2: CONTROLS AND THEIR FUNCTIONS

Power Switch (A)

Turns the set power on and off.

Function Switch (B)

This switch selects the mode of operation for the receiver. Each position selects the following mode:

- **USB** This position is used for CW (continuous wave or code) and upper SSB (Single side-band) operation.
- **LSB** This is the position to use for lower SSB and CW reception.

Stand by

This position cuts off the B supply voltage, making the receiver temporarily inoperative during transmission periods.

AM

This position provides for normal reception of amplitude-modulated signals using diode detection.

AM ANL

This position provides for reception of amplitude-modulated signals under conditions of excessive external interference. ANL stands for Automatic Noise Limiter.

Band (C)

This an 11-position Band Change Switch to cover the international broadcasting bands from 3.5 to 18.0 MHz, the 15 MHz standard frequency signal (WWV) and the 27 MHz CB band.

Tuning (D) (E) (F)

This is the Main Tuning Knob. One revolution controls a 50 KHz linear dial reading. Each indication line on the knob indicates 1 KHz, for frequencies between 3.5 and 30.0 MHz. The dial skirt is held in place by a fiction clutch, which allows easy adjustment for calibration.

Preselector (G) (H)

The Preselector is a three-section air variable capacitor that tunes the input to the RF amplifier, output from the RF amplifier, and the input to the 1st mixer simultaneously. This control can be set approximately to the desired frequency by using the marking on the Preselector dial. After setting to the correct frequency and tuning in the desired signal with the frequency tuning knob, this control must be "peaked" in order for the receiver to provide the optimum in sensitivity.

CAL (I) (J)

The calibrator circuit is crystal controlled and supplies 2 calibration frequencies. By pushing knob (I) to it's "in" position you activate the 25 kHz calibrator, which will provide marker signals every 25 KHz from 3.5 to 30.0 MHz. By pushing knob (J) to it's "in" position you activate the 100 KHz calibrator, which will provide marker signals every 100 KHz from 3.5 to 30.00 MHz.

RF Gain (L) AF Gain (K)

These are concentric controls.

> **(L)** This is the receiver sensitivity control. For ordinary reception it should be set at maximum (extreme clockwise position). It should be adjusted only in such cases where an extremely strong signal from a local station may overload the receiver, causing distortion and a resultant decrease in sound level.
>
> **(K)** This is the volume control. Turn to the right in a clockwise direction to increase volume, and to the left to decrease volume.

S-Meter Readings (M)

The S-Meter provides a means of measuring the relative strength of incoming signals. Relative readings are only correct when the RF-GAIN control is fully clockwise. Measurements are read in "S" units from 1 to 9 and in decibels above S-9 from 0 to 40 dB.

Q Multiplier (N) (O)

(N) Q multiplier selector switch, determines rejection or selection mode.

(O) Tune control, moves the notch or peak thru the passband.

Phones (P)

The Phones jack (J7) provides audio output from the final audio stage. The Phones Jack has an output impedance of 8 ohms. When using the Phones Jack the speaker jack is disabled.

OPERATING INSTRUCTIONS

TABLE 1

CONTROL	AM SETTING	CW SETTING	SSB SETTING
Function	AM or ANL	USB or LSB	USB or LSB
AF Gain	Adjust for desired audio level	Adjust for desired audio level	Adjust for desired audio level
Band Sel	Set for desired range	Set for desired range	Set for desired range
RF Gain	Maximum	Maximum	Maximum
Preselector	Set for desired frequency	Set for desired range	Set for desired range
Main Tuning	Set to desired frequency	Set to desired frequency	Set to desired frequency

TABLE 1 indicates the initial settings of the various controls for each type of operation. Therefore, the degree of strength and clarity with which signal will be received will depend upon proper readjustment of the various controls.

Function

Switch to SSB upper or lower for reception of SSB and CW. and to AM for AM reception. When pulse type interference hampers AM reception, switch FUNCTION to AM-ANL.

Band

Set this switch to the desired band.

RF Gain

Set this control for maximum sensitivity (Full clock-wise position).

AF Gain

Adjust this control for desired volume level.

Pre Selector

Turn this control and set the indicator near the desired band. Adjust for maximum receiver sensitivity.

Tuning

Set the dial indicator to zero. Then push the outer dial lightly and turn it so that it also is set at zero. Now the indications on the outer dial can be directly read down to 1 KHz. The 15 MHz standard signal WWV can be received when the dial reading is at 0 mark.

AM Operation

For the reception of stations place all controls in the positions indicated in the Initial Control Settings chart. Tune in a station, using Main tuning controls as indicated in the section under "TUNING". Adjust Preselector for highest "S" meter reading. This control setting is satisfactory while operating over a limited frequency range. If excessive spurious noises such as those caused by auto ignition make reception difficult, place the FUNCTION switch in the AM ANL position. The automatic noise limiter should be used only when necessary, since it tends to reduce the overall efficiency of the receiver.

CW Operation

The control setting required for the reception of code signals are indicated in the chart. Tune signal to zero beat. The main tuning dial control should then be adjusted on either side of the center for desired pitch.

Signal Sideband Operation

For SSB reception, the dial should be turned very slowly. Excessive signal strength during SSB reception may make demodulation difficult. In such cases decrease the RF GAIN by turning this control to the left. Smooth demodulation will then be possible.

Control settings for sideband reception are virtually the same as for CW. Note, however, that two positions of the function control are provided to permit selection of either the upper or lower sideband, as necessary. The sideband that must be selected will depend upon the band in use. As indicated in the sideband selection chart (TABLE 2), the lower sideband is usually required for SSB reception on 80 and 40 meters, the upper sideband for SSB reception on 20, 15 and 10 meters.

TABLE 2

METERS	FREQUENCY	SIDEBAND USED
80	3.5 to 4.0 MHz	Lower
40	7.0 to 7.5 MHz	Lower
20	14.0 to 14.5 MHz	Upper
15	21.0 to 2l.5 MHz	Upper
10	28.0 to 29.7 MHz	Upper

TABLE 3

SHORTWAVE BROADCAST BAND*	FREQUENCY (MHz)	LISTENING TIME
49 meter band	5.95 to 6.20	Winter nights
41 meter band	7.10 to 7.30	Winter nights
31 meter band	9.50 to 9.775	Nights, all year
25 meter band	11.70 to 11.975	Nights, all year
19 meter band	15.10 to 15.45	Days, all year and Summer nights
16 meter band	17.70 to 17.90	Days, all year and Summer nights
11 meter band	26.95 to 27.50	Days, all year

*These are separate and distinct from the Amateur Shortwave bands, which operate over different groups of frequencies.

On the short wave frequencies there will be found radio stations transmitting from all over the world. Many of these stations provide English-language broadcasts. The frequencies on which most shortwave broadcast stations operate are found in the two upper bands of your receiver. The majority of shortwave broadcast stations operate within certain internationally assigned groups of frequencies, or "bands". For your convenience, a list of the shortwave bands which offer best reception has been provided (TABLE 3). Since shortwave reception varies with the time of day, season of the year and with weather conditions, recommended listening times have also been shown along with each shortwave band.

CALIBRATION AM/CW/SSB

In order for the receiver to be used properly it is important that the dial calibration be checked and set for each band of the receiver. The controls should be set as follows for calibration:

1. Preselector - to marking for desired band
2. Band switch - to desired band
3. Rejection - "OFF"
4. Tuning - Rotate until dial scale "0" appears on pointer.
5. RF - maximum clockwise
6. AF - to suit operator
7. Mode - LSB
8. CAL - 100 KHz.

AM

This control is used to set the dial skirt to exact center frequency of calibration signal. For first setting rotate tuning knob nearest to the 100 KHz maker signal until the tone is in the zero beat. Hold the tuning knob firmly at this point and rotate the dial skirt to zero position. The skirt dial is just behind the tuning knob and is held in position by a friction-locking device. This dial is easily moved by hand but will remain in position after adjustment. In the AM position no calibration tone can be heard, however, accurate frequency location can be determined by observing the "S" meter for maximum indication when tuning thru the calibration signals.

CW/SSB

With the controls set as described above, a marker signal should be heard from the speaker. Rotate the main tuning knob until the tone reaches zero beat. When the tone is at zero beat, turn the "0" marking on the dial skirt to the line marked LSB. This zero beat signal can be heard every 100 KHz. If 25KHz knob is pushed, signal can be heard every 25 KHz. When the function switch is set to USB, tune the "0" marking on the dial skirt to the line marked USB in the same manner. The dial is now calibrated. This same procedure must be followed for dial accuracy when switching to other bands.

Q-MULTIPLIER

The Q-multiplier operates in all modes, CW, AM and SSB, to null unwanted signals with a deep 40 dB notch, or peak the desired signal while sharpening receiver selectivity to help you pick the signal you want out of the noise. The selector switch has off, reject and select positions. A tune control allows you to move the "peak" or "null" throughout the receiver bandpass. When centered, the notch or peak will be in the middle of the bandpass, and moving the control to either side will shift the notch or peak towards either side of the bandpass.

ADDITIONAL FREQUENCY COVERAGE

For coverage other than the International Broadcasting Band, two extra crystal sockets are provided on the RF printed circuit board. Their receiving range is any 500 KHz bandwidth between 3.5-10 MHz and 10.0-30 MHz.

The extra crystal frequency is calculated as follow.

Extra crystal frequency = Low-end frequency of receiving band +2.920 MHz.
For example, if you want to receive 15 Meter Amateur band range from 21.0 to 21.5 MHz.

Extra crystal frequency = 2l.0 MHz +2.920 MHz = 23.920 MHz.
Insert this crystal to the extra crystal socket X11 for receiving range between 10-30 MHz, or X1 for 3.5-10 MHz, and an extra capacitor must be added in parallel with TC-4 for 3.5-10 MHz or TC-l I for 10-30 MHz. The trimmer capacity should be adjusted for correct frequency and also maximum output. The extra capacitor value is shown in Fig. 2-3 and Fig. 2-4.

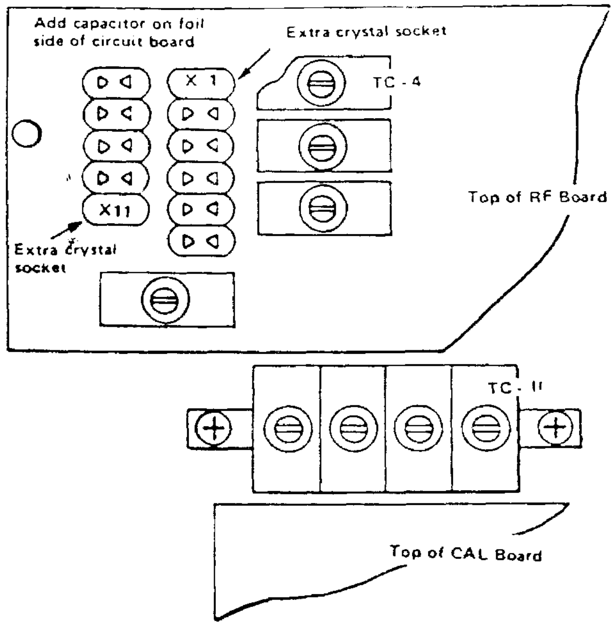


FIGURE 2-2 LOCATIONS OF EXTRA CRYSTAL AND CAPACITOR

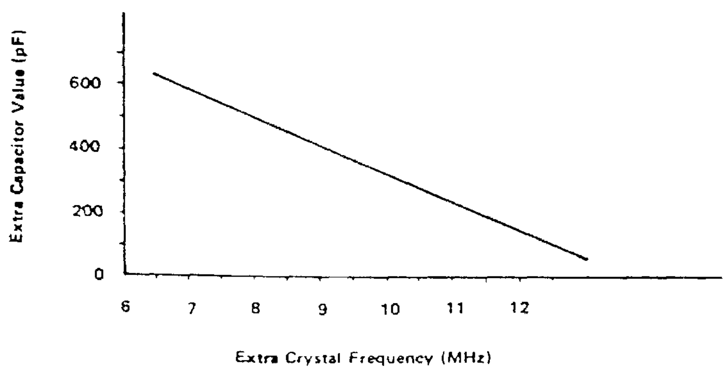


FIGURE 2-3 CHART OF EXTRA CRYSTAL FREQUENCY VS. CAPACITOR VALUE
FOR 3.5 - 10 MHz RANGE

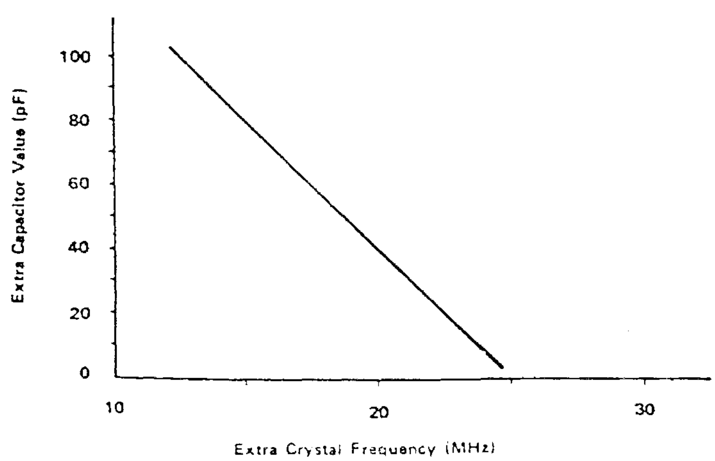
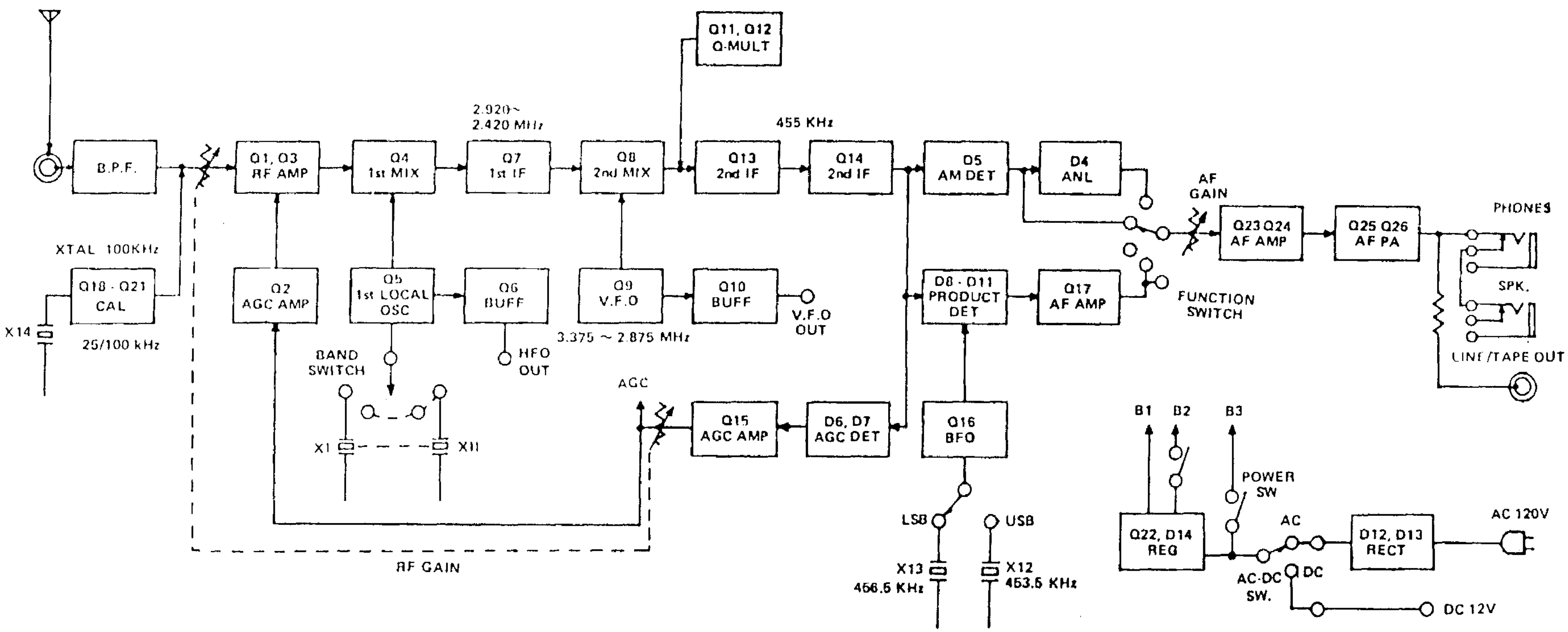


FIGURE 2-4 CHART OF EXTRA CRYSTAL FREQUENCY VS. CAPACITOR VALUE
FOR 10.0 - 30 MHz



BLOCK DIAGRAM OF THE SX-190

SECTION 3: THEORY OF OPERATION

3.1 GENERAL

This section will aid in understanding the operation of the various circuits in this receiver as well as an aid in servicing and diagnosing troubles. The SX-190 is a dual conversion receiver using a crystal-controlled oscillator to provide the first mixing. The first and second mixers are coupled by a band-pass IF circuit 500 kHz wide. The second conversion occurs with the mixing of the 1st IF and the VFO. The low or 2nd IF is amplified and then detected by three different detectors The first detector provides the necessary AGC voltages, the second detector is used for AM reception and the third detector is used for CW and SSB reception. The detected signal is then amplified and applied to the audio output.

The complete circuit of the SX- 190 is shown in the schematic diagram at the rear of the manual. A block diagram is also provided to aid in understanding this receiver. While reading the text it is suggested that both diagrams be followed. The block diagram will reveal the overall scheme, whereas the schematic diagram will provide the detailed circuitry.

3.2 RF AMPLIFIERS AND HIGH FREQUENCY OSCILLATOR

The RF signal received at the antenna is applied to the gate of Q1 (cascode RF Amplifier) thru the antenna input connector J1. The PRESELECTOR control is a 3-section air variable capacitor that tunes the gate and drain of the RF amplifier as well as the gate of the first mixer (Q4). The required tuning range of these circuits is obtained by switching an appropriate value of inductance in parallel with the PRESELECTOR tuning capacitor and its associated coils (T1, T2, & T3). The complete range of 3.5 - 30 MHz is covered by 2 tuning ranges of the PRESELECTOR and by 11 ranges of the crystal controlled high frequency oscillator (Q5). The output of the high frequency oscillator (HFO) is coupled to the source of the 1st mixer as well as the base of an emitter follower (Q6), which is coupled to J2 on the rear panel of the receiver. The emitter follower allows the output of the HFO to be used without any loading effect being placed on the HFO. The RF GAIN control (VR1, 2) varies the AGC voltage fed to the base of the AGC Amplifier Q2, and also attenuates the coupling between T1 and T2. As the setting is changed in a counterclockwise direction, the bias decreases causing a reduction in gain of the RF amplifier stage. The same condition exists when the strength of the incoming signal increases. The output of the RF Amplifier is coupled by T2 and tuned by the PRESELECTOR tuning capacitor to the gate of Q4, the first mixer.

The output of the HFO is always 2.920 MHz higher than the lower edge of the selected band. On frequencies below 17.920 MHz the oscillator collector circuit is tuned to the fundamental crystal frequency; at frequencies above 20.420 MHz the collector circuit is tuned to the third overtone of the crystal.

3.3 FIRST MIXER AND BANDPASS IF

The output of the RF Amplifier is applied to the gate of the first mixer Q4. At the same time the output of the HFO coupled thru T4 is applied to the source of the first mixer. The two signals are mixed and their products are selected in the drain circuit of Q4. The circuit in the drain of Q3 is tuned as a bandpass circuit passing all frequencies between 2.920 MHz and 2.420 MHz. This is the frequency range of the 500 KHz bandpass IF. The transformers L8, 9 and Ll0 and their associated components comprise the bandpass IF. The output of this IF is applied to the base of Q8, the second mixer.

3.4 SECOND MIXER AND VARIABLE FREQUENCY OSCILLATOR

The second mixer combines the output of the bandpass IF with the output of the variable frequency oscillator (VFO) to produce the 455 KHz IF.

The VFO produces the required frequencies for tuning LSB, USB, CW and AM signals. Inductor T7 parallels capacitor VC6, in the frequency-determining network. The output frequency is lowered causing the VFO to tune from 3.375-2.875 MHz.

The mixing products of the bandpass IF and VFO are selected in the collector circuit of Q8 (second mixer). The output of the VFO is provided at the rear panel at J4. Here the VFO is isolated by emitter follower (Q10).

3.5 455 KHz IF DETECTOR CIRCUITS AND NOISE LIMITER

Immediately following the 2nd mixer (Q8) are the mechanical Filters (MF1, MF2). Output from the MF1 is amplified by Q13 and connects to MF2 and is tuned by the three transformers T9, T10 and T11. The signal is taken from the secondary of T11 to be detected and used as the AGC voltage.

The AM detector, diode D5, also gets its signal from the secondary of T11 and is coupled to the noise limiter (D4). This noise limiter only functions in the AM mode when its output is delivered through the function switch, on to the AF GAIN and to the 1st audio amplifier.

The detection of CW & SSB signals is accomplished by D8, D9. Dl0 and D11. These four diodes comprise a balanced demodulator circuit. The audio is developed from the product detection of the incoming 455 KHz signal and the output of the BFO, which may come from the crystal controlled SSB oscillator, and its output is delivered to AM preamplifier (Q17). The output of the AM preamplifier is coupled thru C79 to Function switch (SW3-d) to the AF gain control, VR3, and on to the 1st audio amplifier.

3.6 AUDIO CIRCUITS

As stated earlier the audio voltage developed by a particular detector is coupled through the Function switch (SW3-d) to the AF Gain control (VR3). The audio voltage is amplified in three separate stages. The first audio amplifier Q23 feeds the second audio amplifier Q24 that drives the final audio output stage, which is operating push-pull, and consists of transistors Q25 and Q26.

The audio system has been designed to provide three different audio outputs. J6 is an 8-ohm phone output for a head-phone. Jack J7 is also an 8-ohm speaker jack. The third audio output J8 is a 600-ohm output jack, which can be used for tape out and/or line out operation.

3.7 BFO AND CW OSCILLATOR CIRCUITS

BFO circuitry consists of the transistor Q16 and it associated circuitry. In the reception of LSB and USB signals the Function switch will place either X12 or X13 (USB or LSB) in the base circuit of Q16. Q16 now functions as an oscillator providing the necessary frequency to the balanced demodulator for the beat between the 455 KHz IF signal. In the LSB position of the Function switch X13 is in the circuit producing a frequency of 456.5 KHz. In the USB position, X12 produces a frequency of 453.5 KHz.
(X: Crystal)

3.8 AGC AND "S" METER CIRCUITRY

Signal voltage is coupled from the primary of T11 to AGC detector D6 and D7. The AGC amplifier Q15 amplifies the rectified signal voltage.

The collector voltage of Q15 is divided by R65 and VR2, and it is applied to the IF and RF amplifier stages. Emitter voltage of Q15 is used for "S" meter circuit.

The AGC time constant is controlled by C65 and thru C64. In the USB and LSB position the parallel combination of C64 present a larger time constant resulting in a slower AGC discharge rate.

The RF GAIN control VR2 provides a manual control of the gain in the RF, 1st, 2nd mixer and IF stages. The RF Gain control is in series with the bases and controls static bias to these stages As the control is rotated counter-clockwise the bias voltage decreases, reducing the bias and therefore the gain of the stages.

3.9 REJECTION FILTER

The Rejection Filter consists of transistors Q11, Q12 and their associated components. The frequency of the notch is controlled by VC7, REJECTION TUNING. This control allows the notch to be moved across the passband of the 455 KHz IF. Resistor, VR15, is used to adjust the depth of the notch.

This notch circuit is an inverted "Q" multiplier. The circuitry around Q12 multiplies the "Q" of coil T7. By multiplying its "Q", the circuit provides a narrower notch. This circuit shapes the notch and VR15 sets the depth. The output of this circuit is actually a peak rather than a notch until it is inverted by Q11, then it appears as a notch when tuned through the IF passband.

3.10 CALIBRATION CIRCUIT

Calibration circuitry consists of transistors Ql8 thru Q21. 100 KHz signal is produced by Q21 and connected to buffer amplifier transistor Q18. And every 100 KHz harmonic is supplied thru C80. Q19 and Q20 are multivibrators to oscillate at 25 kHz. It is also connected to buffer amplifier and to C80.

3.11 POWER SUPPLY

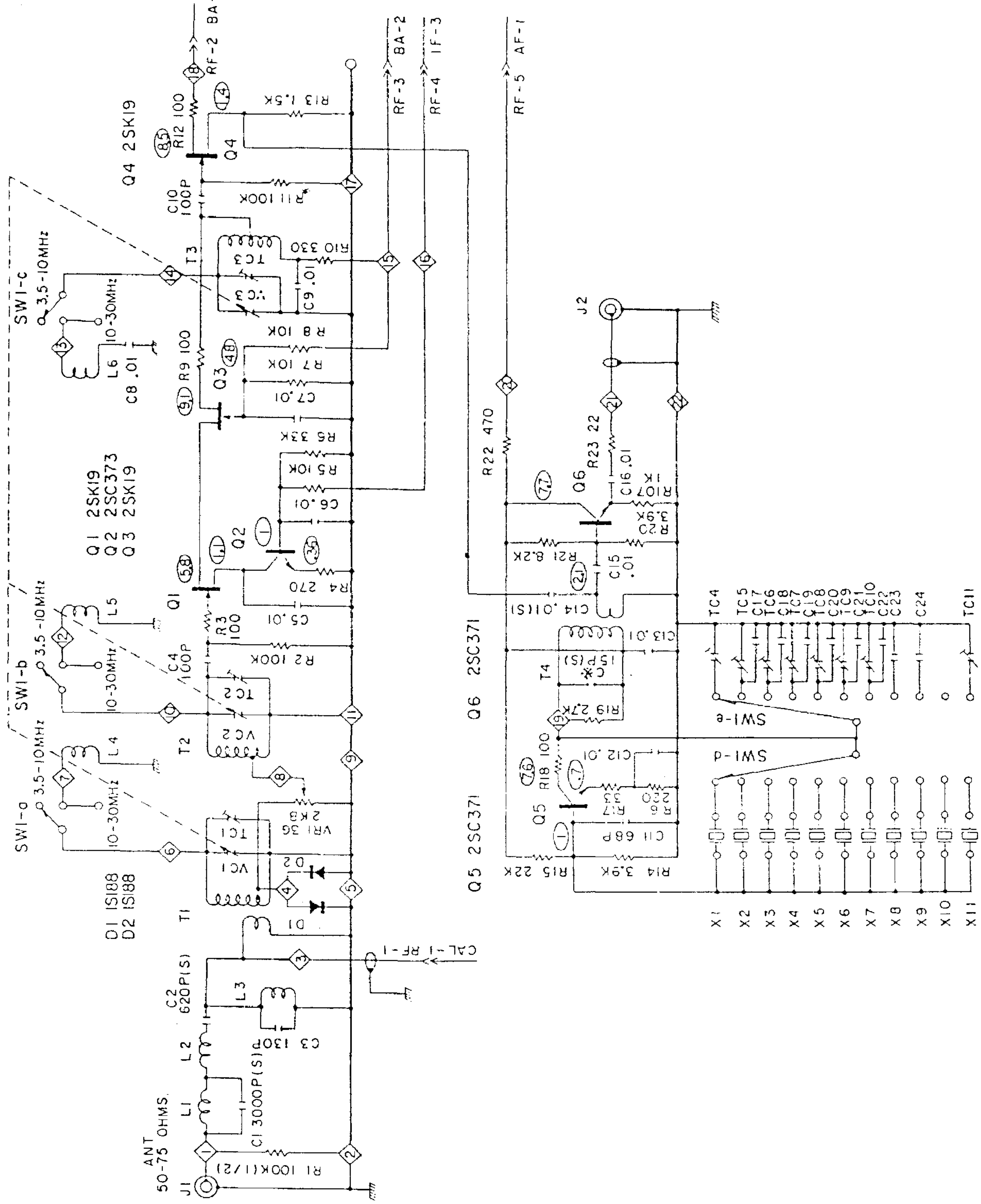
The power supply of the SX-190 has the advantage of operating from 120 VAC 60 Hertz or 12 VDC without any internal wiring changes.

3.11.1 AC POWER SUPPLY

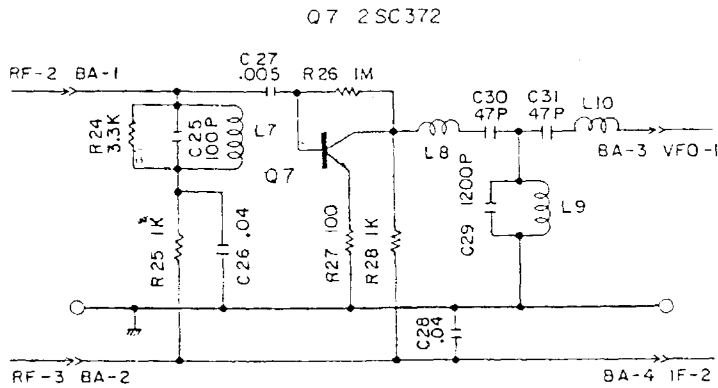
Transformer T13 steps down the voltage from the source to a nominal voltage of approximately 10 Volts. This voltage is then rectified by the diode consisting of diodes D12 and Dl3. This rectified voltage is then fed to the collector Q22. In the base circuit of Q22, a 10V Zener regulator is used to regulate the base potential. Transistor Q22 is used as an emitter follower regulator. From here the 9.5V supply line is taken, and also the 7V supply line originates thru a dropping resistor R82. The 7V supply line is regulated by a 7V Zener Diode D3.

3.11.2 DC POWER SUPPLY

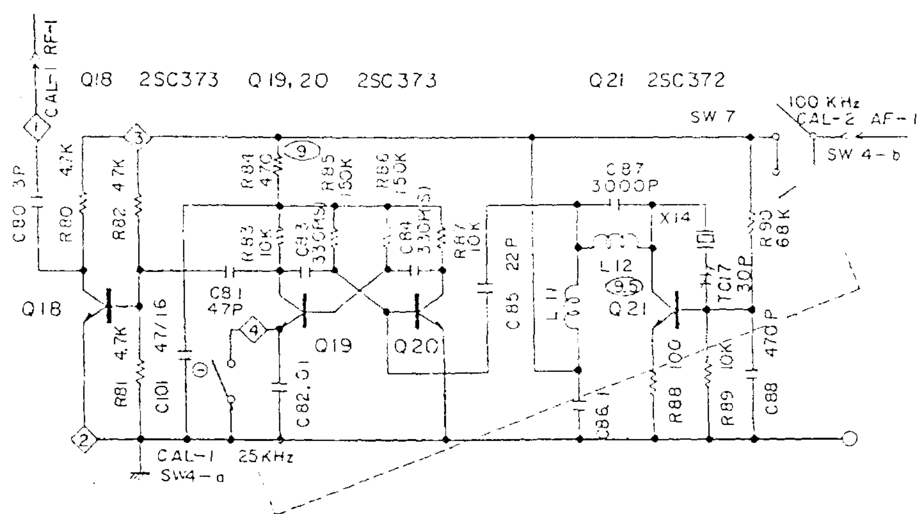
There is no DC power supply as such. The receiver merely regulates and fuses the 12 VDC source.



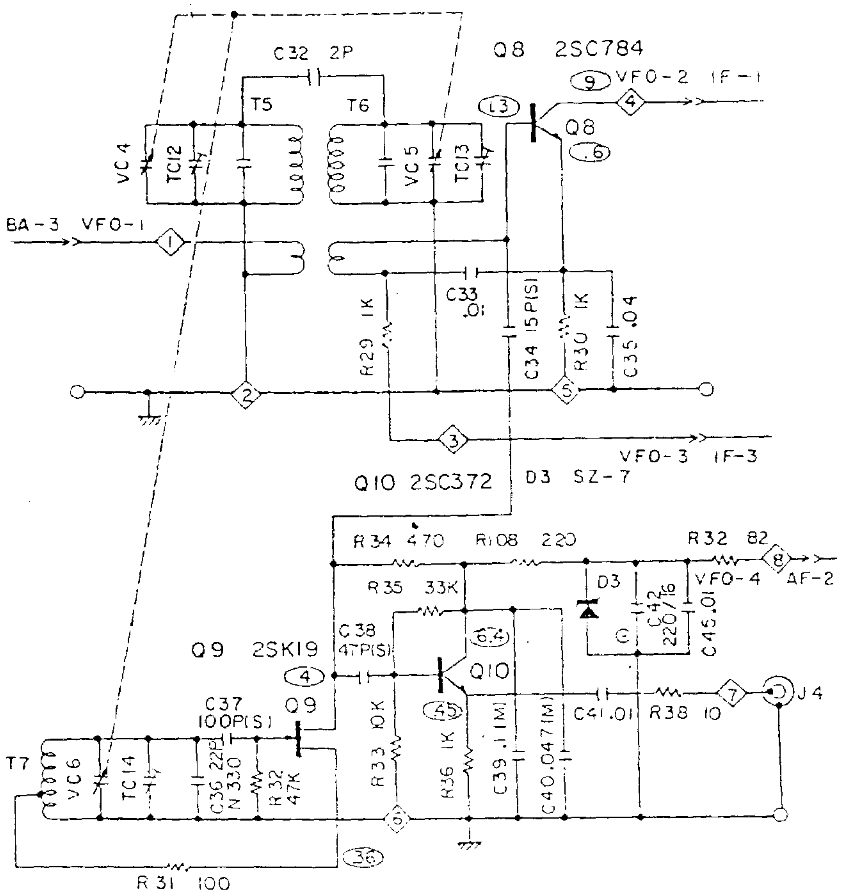
SCHEMATIC DIAGRAM OF RF AMP



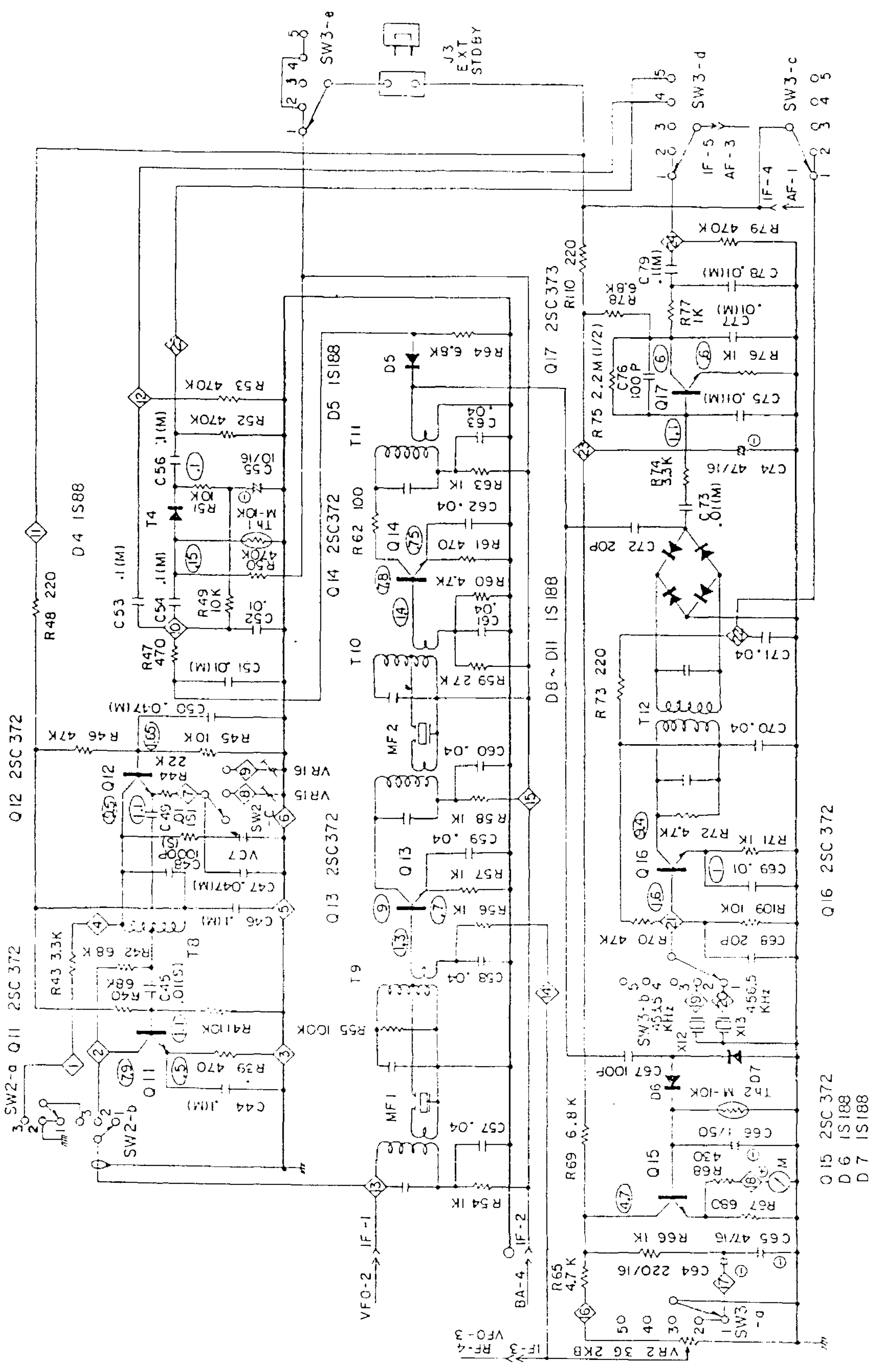
SCHEMATIC DIAGRAM OF BUFFER AMP



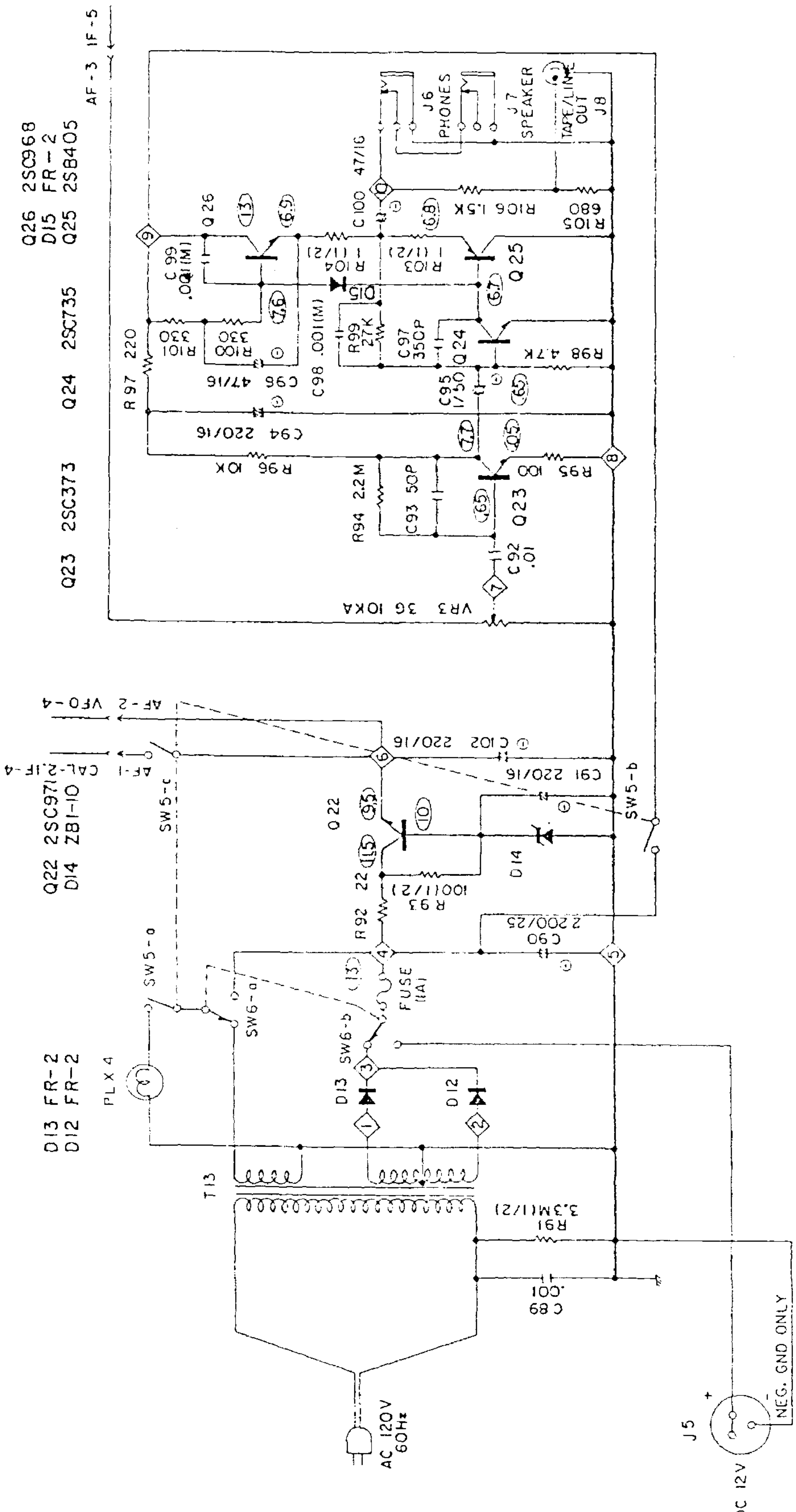
SCHEMATIC DIAGRAM OF CALIBRATOR



SCHEMATIC DIAGRAM OF VFO SECTION



SCHEMATIC DIAGRAM OF I.F. AMP SECTION

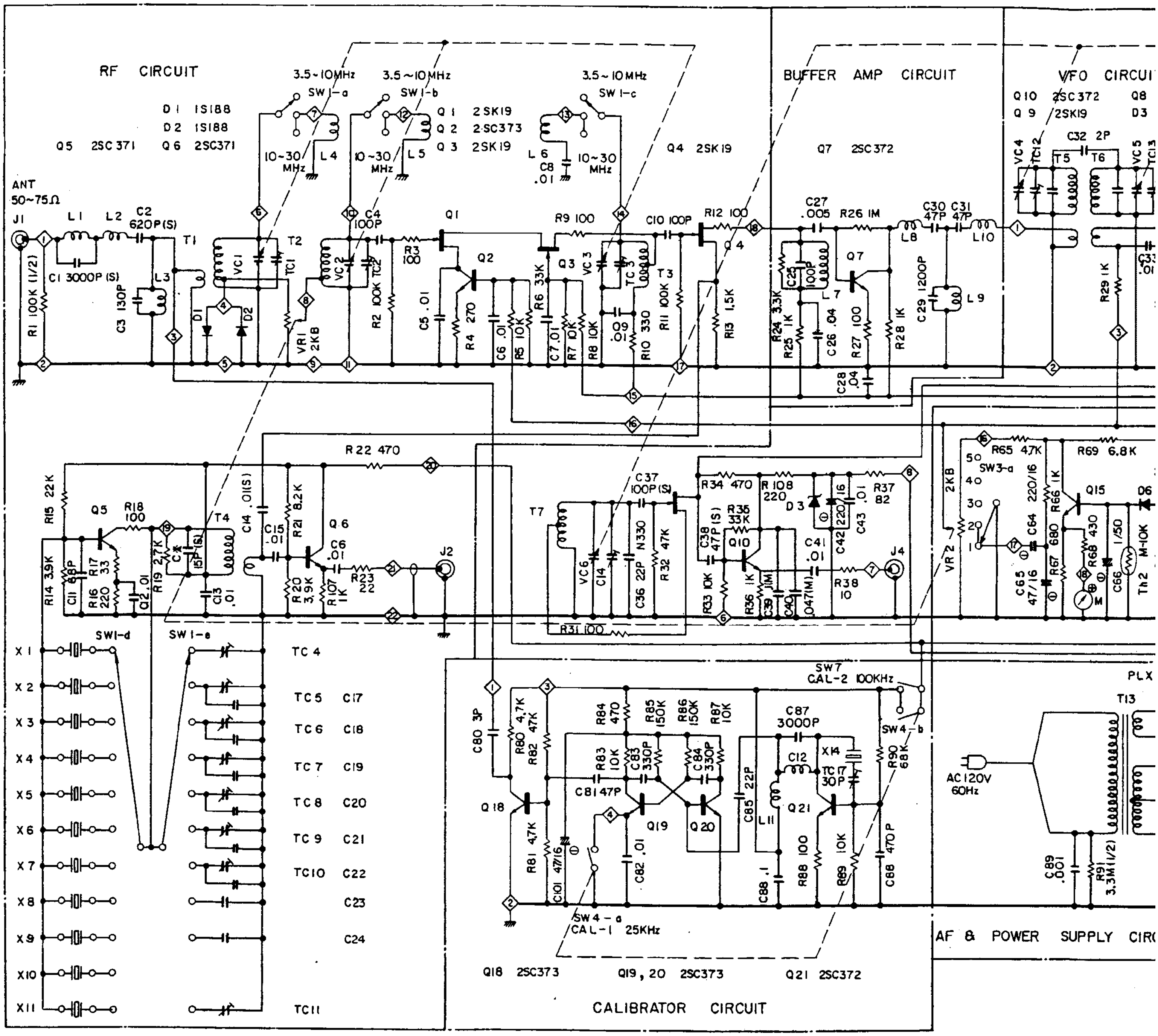


SCHEMATIC DIAGRAM OF POWER SUPPLY

TRANSISTOR AND DIODE COMPLEMENT

Q 1	2SK19	Cascode RE Stage
Q 2	2SC373	AGC Amp.
Q 3	2SK19	Cascode RF Stage
Q 4	2SK19	1st Mixer
Q 5	2SC371	1st Local Osc.
Q 6	2SC371	1st Local Osc. Emitter Follower
Q 7	2SC372	1St IF Band Pass Amp.
Q 8	2SC784	2nd Mixer
Q 9	2SK19	Variable Frequency Osc.
Q10	2SC372	Variable Frequency Osc. Emitter Follower
Q11	2SC372	"Q" Multiplier Inverter
Q12	2SC372	"Q" Multiplier
Q13	2SC372	2nd IFAmp.
Q14	2SC372	2nd IF Amp.
Q15	2SC373	AGC Amp.
Q16	2SC372	BFO
Q17	2SC373	AF Amp.
Q18	2SC373	CAL. Buffer Amp.
Q19	2SC373	25khz Multivibrator
Q20	2SC373	25kHz Multivibrator
Q21	2SC372	100kHz Calibrator
Q22	2SC971	Regulator
Q23	2SC373	AF Amp.
Q24	2SC735	AF Driver Amp.
Q25	2SB405	AF Power Amp.
Q26	2SC968	AF Power Amp.

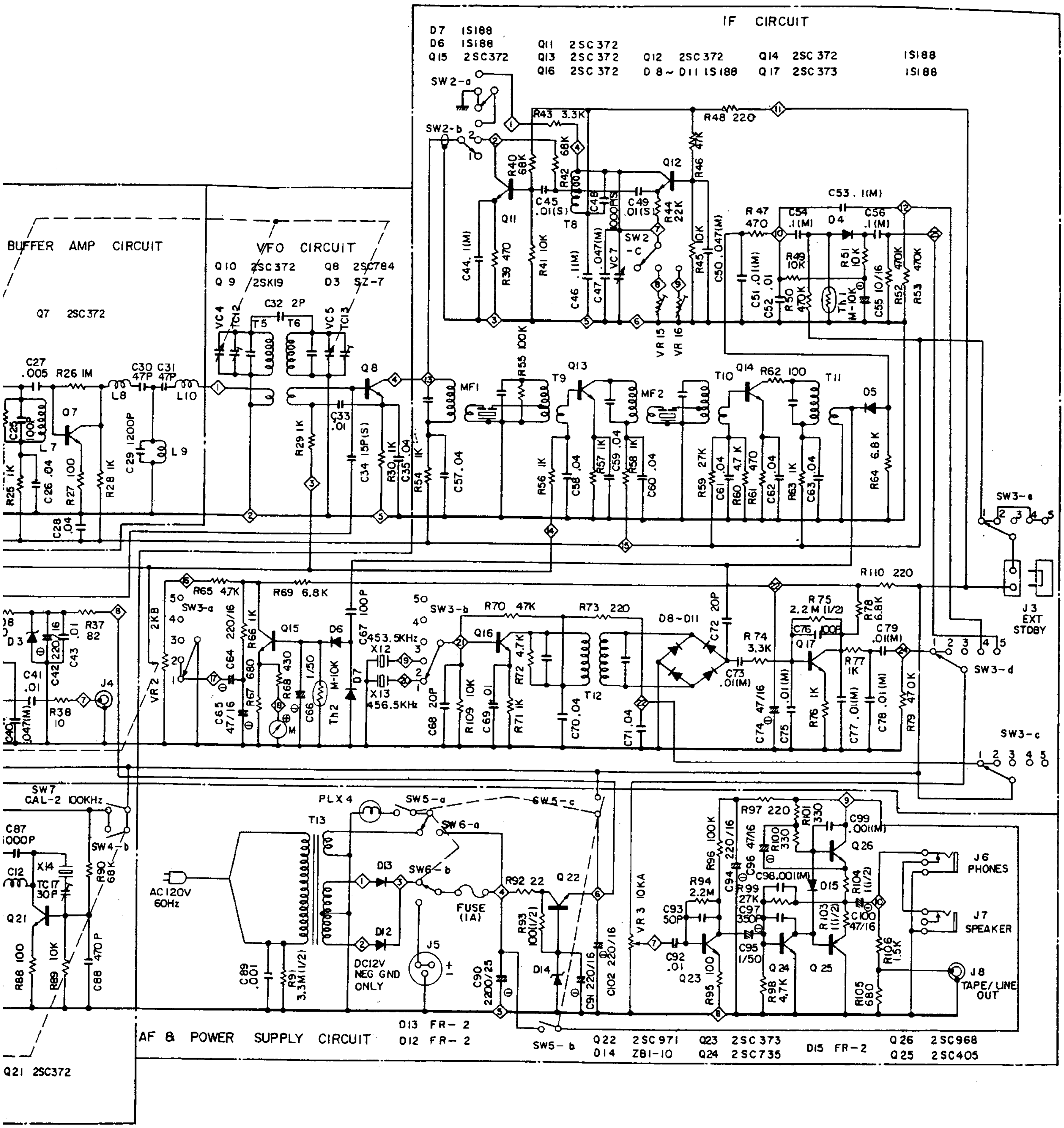
D l	1S188	Overload Protector
D 2	1S188	Overload Protector
D 3	SZ7	7V Voltage Regulator
D 4	1S188	ANL
D 5	1S188	AM Detector
D 6	1S188	AGC Detector
D 7	1S188	AGC Detector
D 8	18188	Product Detector
D 9	18188	Product Detector
D10	1S188	Product Detector
D11	1S188	Product Detector
D12	FR-2	Rectifier
D13	FR-2	Rectifier
D14	ZB1-10	10V Voltage Regulator
D15	FR-2	Temperature Compensator
TH 1	M-10K	Temperature Compensator
TH 2	M-10K	Temperature Compensator



REMARKS:

RESISTANCE VALUES IN OHMS. K = 1000 M = 1000000

CAPASITANCE VALUES IN MF. P= MMF



VALUES IN OHMS. K=1000 M=1000000
E VALUES IN MF. P= MMF

COMPLETE SCHEMATIC DIAGRAM OF RECEIVER

ALLIED RADIO SHACK A TANDY CORPORATION COMPANY
FORT WORTH, TEXAS 76107

PRINTED IN JAPAN