

KENWOOD

HF TRANSCEIVER

TS-870S

Intelligent Digital Enhanced Communications System

CIRCUIT DIAGRAM MANUAL

KENWOOD CORPORATION



Making super radio out of TS-870



KB2LJJ

Radio Mods Database

Making super radio out of TS-870

I loved the TS-870 when I first got it. Size is ideal for expedition radio, light weight, fits in carry on luggage. Features and computer controls are excellent, until I used it in the contest on 160m. Bloody thing got overloaded with signals 4 kHz away. Everybody was QRming me! What a piece of binMaking super radio out of TS-870 king junk! Liking to inquire at Kenwood about the problem of overload. They came up with modification to remedy the gain distribution in the RF and mixer stages, which was implemented in later production models. After I received the service manual, I started to dig into the radio and came up with few more improvements.

Earlier production units before S/N 801xxxxx had problem with front end overload and consequent distortion and crossmodulation in the later stages, including DSP, especially noticeable on low bands. To remedy that on those earlier units see the Overload Modification.

There is an absence of 2nd RX antenna switching (Beverages, etc.). When I inquired at Kenwood, they supplied modification instructions that required some drastic modifications, including cutting the traces. When I obtained service manual, I figured very elegant modification using just plug in diode. See 2nd RX Antenna Switching modification.

Examining the circuits and filtering arrangement, I have found that Kenwood engineers decided to rely on obtaining the selectivity mainly by using the DSP. Theoretically it is great, except when strong signals blow by the mediocre crystal filters used in stock TS-870, they modulate the following stages, including DSP circuits. The biggest improvement that puts this radio one class higher, is to replace the stock 2nd IF crystal filter and 3rd IF monolithic ceramic filter with high quality International Radio or other filters. Any better shaped filters make tremendous improvement to the selectivity, overload and DSP performance. Depending on intended use, you can use 2.7, 2.4 or 2.1 kHz bandwidth filters. I chose 2.1 mainly for contesting purposes. It is possible to use narrower filters for CW operation, but selectivity selection scheme via microprocessor controlled switching makes it complicated and throws the controls off their markings. I found that 2.1 filters work very well even for CW and are significant improvement over stock arrangement. See Filter Modification.

Overload Modification

NOTE: the changes do not apply to radios with S/N 801xxxxx and later.

Problem:

If there is any strong signal in the proximity on the low bands, it will cause crossmodulation and create a "ghost" signal. It may occur in the contest operation or during the pile-up reception.

Cause:

A larger power input signal causes the second mixer output, the NB amplifier input, the third IF amplifier input, and the third IF amplifier output to be saturated.

Remedy:

Change the gain allocation of the IF stage to raise the limit of saturation. This modification will cause almost no deterioration of receiver sensitivity.

Circuits from the antenna terminal onward:

Sequence is:

Antenna, amplifier, mixer, 73.05MHz filter

Amplifier, mixer, 8.83 MHz filter - noted gain is -10dB (minus 10)

Amplifier, mixer, 455kHz filter

Two Amplifiers - noted gain is +10dB (plus 10)

Replace the following components with (Kenwood part numbers)

Caution: they are all SMT chips, you need to be familiar with SMT soldering procedures.

Changes to circuit board XX4-3210 (A/9) RF UNIT

R1157 : replace 1.8k with 560 (RK73FB2A561J)
 R160, R161: 2.2k with 1k (RK73FB2A102J)
 R164 : 1.5k with 560 (RK73FB2A561J)
 L76, L79 : 3.3uH with 0(zero) (R92-0670-05)
 R169 : 1k with 330 (RK73FB2A331J)

X57-4620 TX-RX UNIT

R332 : replace 2.2k with 6.8k (RK73FB2A682J)

Adjustment:

Do not forget to perform the re-adjustment of the S-meter sensitivity after making the modifications.

Refer to "8. S-meter adj." on P.95 of the Service Manual for how to do it specifically.

If you cannot adjust the display to "05", even after you follow the steps described in "8. S-meter adj.", change the resistor as instructed below and make the re-adjustment.

X57-4620 TX-RX UNIT

VR-1 : 470 ----> 3.3k (R12-6737-05)

2nd RX Receive Antenna switching modification

Kenwood TS870 has two antenna jacks ANT1 and ANT2 and external receiver antenna jack (RCA type) that can accommodate external receiver when activated through the program menu. This adds some attenuation to TS870 receiver signals. There is no provision for external receive antenna switching (Beverages, preamp., etc.) When I inquired Kenwood about this option, they sent me modification instructions that required cutting the traces and rewiring the ext. RX connector. When I received my Service manual and had a look at the circuit, I came up with this simple modification:

Parts needed: 1 diode (any type) I used rectifier diode, generic NTE125

Step by step instructions:

1. (In the following references the front panel of the rig is facing you.) Remove the top cover.
2. Remove 7 screws holding the cover over the FILTER and RELAY unit (in the middle) and remove the cover. (Where the ANT1 and ANT2 connectors go.) This exposes two PC boards.
3. Locate the connector CN301 on the RELAY unit (adjacent to ANT1 and ANT2). It is about 1 inch back and 1 inch left from the ANT1 connector and has three wires going to it - two gray, left and one black, right.
4. Take the diode, clip the leads to about 0.5 inch length, bend them down and form them so they are spaced about 1/8" and parallel (kinda forming letter Y).
5. Plug the diode into CN301 connector from the top, pushing the diode wires between the plastic housing and the metal contacts of the connector. Cathode (the end with the band marking) of the diode should go to the middle contact (gray wire), the other end to the left contact (gray wire). Make sure that diode makes good contact with terminals of the connector. Black wire should be free.
6. That completes the modification. Replace the covers, do not pinch the wires going to the antenna tuner!

Operation:

Connect your transmit or main antenna to the ANT2 connector. Connect your receive antenna or preamp output to ANT1 connector. Now you can transmit only through ANT2 connector.

Front panel button ANT now allows you to select ANT2 (receive/transmit on ANT2) or ANT1 (receive on ANT1, transmit on ANT2). Antenna tuner would always see the impedance on ANT2. The way the switching works, whenever you transmit, you will switch ANT2 on transmit, regardless of ANT1 or ANT2 selection. Much better use of connectors than originally devised by Ken Wood

Notes on TS870 usage: Normally there is enough gain on the receiver for beverages. In case that you need to use the preamp or preselector, than turn the AIP on TS870 on, and if needed add the attenuators. Try to keep the noise level peaks close to low end of the S-meter scale. Helps with intermods. If using DSP, play with different settings and different levels of AGC setting, it has effect on overall behavior.

Filter Modification.

Major improvement in selectivity and DSP performance can be achieved by replacement of 2nd and 3rd IF filters with sharp crystal filters, like from International Radio. The 2nd IF 8.83 kHz filter used in TS870 is the stock Kenwood crystal filter, while the 3rd IF 455 kHz filter is little ceramic Murata filter.

I have ordered set of 2.1 kHz filters (8.83 and 455) from IR. The modification involves removal of printed circuit boards where the filters are located, unsoldering the old filters. In their place solder short piece of miniature coax to connect new IR filters. IR filters can be mounted between the circuit boards and the metal chassis using double sided sticky tape. Coax from old filter connections is then connected to new filters. Tweaking the matching IF transformers next to the filters ensures proper match and gain.

Other filters with wider bandwidth can be used also. For contesting I found 2.1 filters to be the best and the mod works very well on CW also. Selectivity improves as well as functions of DSP. Now it is a decent radio, matching those costing thousand(s) more.

Good luck and I am not responsible for any goofups you make! :-)

DSP PROMs

OK2RZ reported distorted or muffled audio when experiencing SSB pileups as compared to TS850. Upon investigation and with some help we were able to identify the problem.

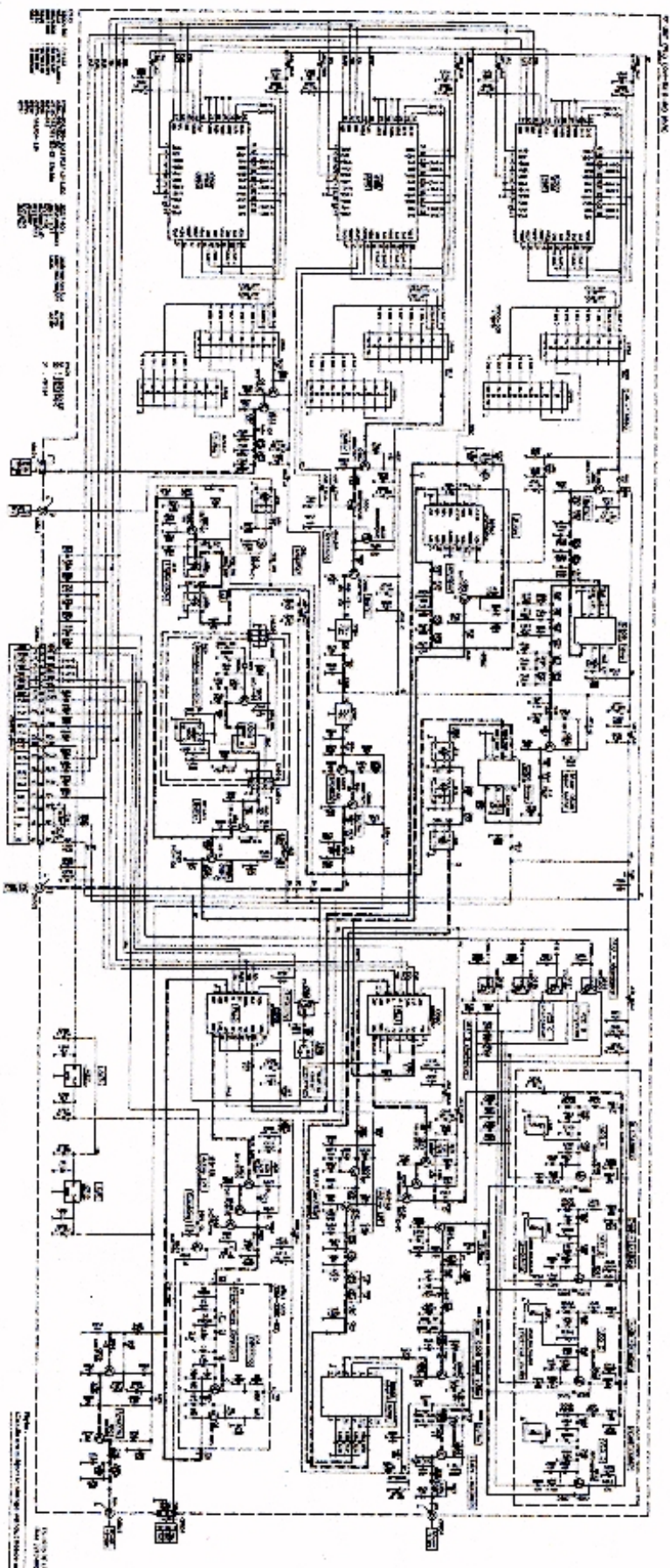
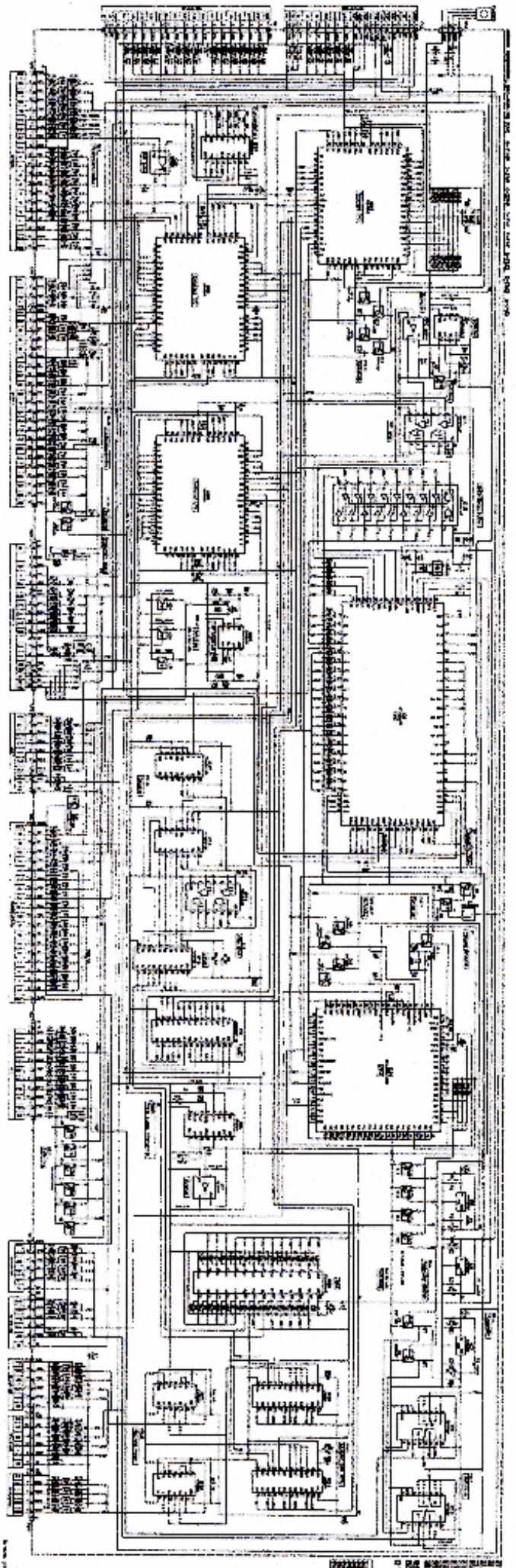
The distortions and problems with decoding of SSB signals by DSP circuits are indeed present in the older versions of TS870S. The fix is in replacing 3 PROMs with the newer version. The latest part numbers are:

Qty	Part Number	Description
1	27C256PCJJTF	EPROM IC
1	27C256PCJJUF	EPROM IC
1	27C256PCJJVF	EPROM IC

Check your radio. (No idea what SN change took place.) They are located at the bottom left half (RX/TX board), behind the shield. The important letters are the second before last (T,U,V) indicating the present latest version. I checked Kenwood authorized service center, they wouldn't sell the chips. They have to be ordered from Kenwood parts centers. Price is \$29.53 each.
(From East Coast Transistor <http://www.kenwoodparts.com/>)

I have not received any answers from Kenwood, their service centers claim PROMs fix some problem with S-meter spikes - so much for customer service. They should be replacing all the old PROMs without charge, this is design problem.

This should help to keep your 870s, excellent midrange radio for contestator, expeditioner, portable, computer/remote control.



SCHEMATIC DIAGRAM

