KENWOOD TS-940 PAGE

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Version 14: 22 March 2006, Version15: * April 2006

From a passionate Kenwood TS-940 owner. The 940 has to be one of the greatest transceivers ever produced.

This page is provided because:

- Some information here is not available anywhere else and should be useful to any TS-940 owner,
- Information does not exist in a single web site which is easy to follow,
- If the information remains available more TS-940s will be repaired and functional, (and probably improved),

The intention is to acknowledge the person who discover the information so questions can be sent to that person.

When information is already well documented and reliably maintained on another site then a hyperlink is made to that site to avoid yet another slightly different version.

I will publish all email feedback at the end of the page, so that whatever is discovered by others can be shared by all. Please email to jaking@es.co.nz

Yours sincerely
Jeff King ZL4AI / DU7

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What is new in Version 15:

SUMMARY OF R149 AND R150 MIS-LABELLING

What is new in Version 14:

BATTERIES: [INTERNAL]

BATTERY REPLACEMENT
CW FILTERS
Motor bearings gummed up

Field measurements of receiver improvement following FET swap

What is new in Version 13:

PROMOTIONAL BROCHURE

SERVICE MANUAL & SERIAL NUMBERS

What is new in Version 12:

PLL Board 4: PLL Board and RF Board and PLL out of lock

AVR BOARD & POWER SUPPLY

FAN AND TEMPERATURES
COOL AVR COMPONENTS BY REMOUNTING ON HEAT SINK
Power Supply HEAT SINK RUNS TOO HOT
VERIFY THERMISTOR 101 IS ATTACHED AND FUNCTIONING

INDEX

PROMOTIONAL BROCHURE

RECEIVER PERFORMANCE IMPROVEMENTS.

R1. KENWOOD PRODUCED 3 SERVICES BULLETINS which do considerably improve the receiver.
RECEIVER 2. FIELD EFFECT TRANSISTORS AROUND THE WRONG WAY.
RECEIVER 3. THERE IS NO AGC TIMING CORRECTION
SUMMARY OF R149 AND R150 MIS-LABELLING
Mike KC8ZNW on 25/4/05 describes this same behaviour to the Kenwood.net.
Executive Summary of AGC Mod
Independent Feedback on how Receiver Improves
THE PRODUCTION MISTAKE DESCRIBED:
TO CHANGE THE RESISTORS
THE INITIAL PROBLEM SYMPTOMS:
ACKNOWLEDGEMENTS TO PERSONS WHO HELPED SOLVE THIS
A CAUTION:
COMMUNICATIONS WITH KENWOOD JAPAN BELOW:
RECEIVER 4. PIN DIODE IMPROVEMENTS
4.1: Background on how Pin Diodes were discovered to improve radios.
4.2 RadCom Technical Topics explains what Pin Diodes were supposed to achieve.
Intermodulation properties of switching diodes, by Dr. Ing. Jochen Jirmann, DB1NV
4.3: Summary of Key points on Purpose of Pin Diodes: [by ZL4AI]
4.4 Experience from Persons who modified the TS-940
4.5 : Pin Diode Modification for TS-440
4.6: So summary of Pin Diode Modification

PLL BOARD PROBLEMS

PLL BOARD 0: RESEAT CONNECTORS
PLL BOARD 1: REMOVE THE BLACK FOAM FROM BEHIND THE BOARD
PLL BOARD 2: REMOVE THE WAX FROM THE VCOS
PLL BOARD 3: IDENTIFY WHICH PLL IS NOT LOCKED
PLL BOARD 4: PLL BOARD AND RF BOARD AND PLL OUT OF LOCK

CONTROL BOARD

VOLTAGE REGULATOR HEATS UP AND CAUSES A SHIFT IN BFO ON IF BOARD

AVR BOARD & POWER SUPPLY

FAN AND TEMPERATURES
COOL AVR COMPONENTS BY REMOUNTING ON HEAT SINK
POWER SUPPLY HEAT SINK RUNS TOO HOT
VERIFY THERMISTOR 101 IS ATTACHED AND FUNCTIONING
REPLACE Q101 AND Q 102
MOTOR BEARINGS GUMMED UP: TEMPORARY FIX

RF BOARD 1: BOARD RUNS VERY HOT

HOW IT WORKS

AM MODE: HOW TO VERIFY ITS SWITCHED IN
FM MODE: SETTING FM CARRIER
CW FILTERS

SERVICE MANUAL & SERIAL NUMBERS

IDENTIFYING WHEN RADIO MANUFACTURED

BULBS

CONNECTOR PROBLEMS

BATTERIES: [INTERNAL]

BATTERY REPLACEMENT

INFORMATION NOT ANNOUNCED BY KENWOOD:

KENWOOD RELEASED INFORMATION:

S METER ALIGNMENT LEVELS

PARTS

LINKS TO USEFUL SITES

HELP WANTED

PERFORMANCE COMPARISONS

MODIFICATIONS

POWER SUPPLY IMPROVEMENTS
ALC DELAY TIME:
TS-940 AVERAGE OUTPUT POWER SSB
USE OF TS940S FSK RECEIVE FOR HF PACKET
INQUIRY REGARDING USE OF ADDITIONAL RECVR.
GEIL CHIP

FEEDBACK FROM READERS

PROMOTIONAL BROCHURE


TRIO
HF TRANSCEIVER
TS
supplied by ZL4AI / DU7
POWER
TIMER
VOX
FULL
MONI
DIM
MAN
SEMI
OFF
NOR
TRIO
HF TRANSCEIVER TS-940S
ATT
AGC
METER
MODE
FUNCTION
MEMORY
CLOCK

TS-940S

HF TRANSCEIVER

The TS-940S is a competition class HF transceiver having every conceivable
SSB, CW, AM, FM and FSK modes of operation on all 160 through 10 metre A
new WARC bands. It incorporates an outstanding 150 kHz to 30 MHz general
superior dynamic range (102 dB typical on 20 meters, 50 kHz spacing, 500 H

Engineered with the serious DX'er/contest operator in mind, the TS-94C
innovative interference rejection circuits, including SSB IF slope tuning, CW
tuning), IF notch filter, AF tune circuit, Narrow/Wide filter selection, CW variab
noise blanker, and RIT plus XIT. The use of a new microprocessor with a
controlled operating features, plus two VFO's, 40 memory channels, progra
scans, a large fluorescent tube digital display with analogue-type sub-scale fc
a new dot-matrix LCD sub-display for showing graphic characteristics and me
maximum flexibility and ease of operation. In addition, a CW full break-in
break-in, a built-in automatic antenna tuner, a solid-state final amplifier tha
voltage source, a speech processor, all-mode squelch, and a host of other conv
to even greater versatility of use in fast-paced DX operations. With its power
built-in, and with its new whisper-quiet cooling system, the TS-940S is a
transceiver that brings tomorrow's sophistication to today's serious enthusias
with the antenna tuner installed or available as an option.

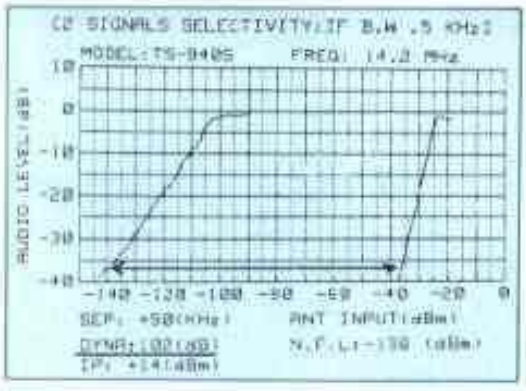
supplied by ZL4AI / DU7

FEATURES

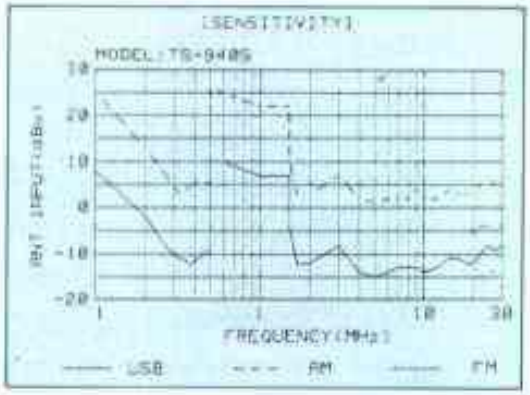
OUTSTANDING RECEIVER PERFORMANCE AND SENSITIVITY SPECIFICATIONS

Superior Dynamic Range Receiver Front End.

The TS-940S RF circuits have been specifically designed to provide the lowest noise floor level coupled with a superior dynamic range. Use of 2SK125 junction-type FET's wired in a cascode amplifier circuit, followed by two 2SK125's each in the first balanced mixer and in the push-pull gate grounded buffer amplifier, and working into a 2nd balanced mixer circuit, results in outstanding two-signal characteristics accompanied by a substantially improved noise floor level. The IM (intermodulation) dynamic range characteristic for the TS-940S receiver section is typically 102 dB (20 metres, 50 kHz spacing, 500 Hz CW bandwidth), with an overall intercept point of +14 dBm, noise floor level of −138 dBm and the blocking dynamic range at a point 200 kHz to either side of the centre frequency of the IF filter is −139 dB (typical).



conceived and engineered digital PLL circuit provides superior frequency accuracy and stability since only the standard frequency crystal oscillator determines those parameters. Selection of a specific Amateur band may be speedily and efficiently accomplished by the touch of the appropriate band access key (10 keys provided), or through use of the UP/DOWN 1 MHz step band switches, allowing easy access to all frequencies in the 150 kHz to 30 MHz range. Each of the two digital VFO's is continuously tunable from band to band across the full range of the transceiver.



All-Mode Operation.

Modes of operation include USB, LSB, CW, AM, FM, and FSK. Mode selection is quickly effected through use of the proper front panel mode key. An adjacent LED confirms the selection. When a key is depressed, the first letter of the mode selected is announced in Morse code through the internal speaker, e.g., "L" for LSB, "F" for FM, etc. When FSK is selected, the Morse code letter "R" (for RTTY) is heard.

Superb Interference Reduction.

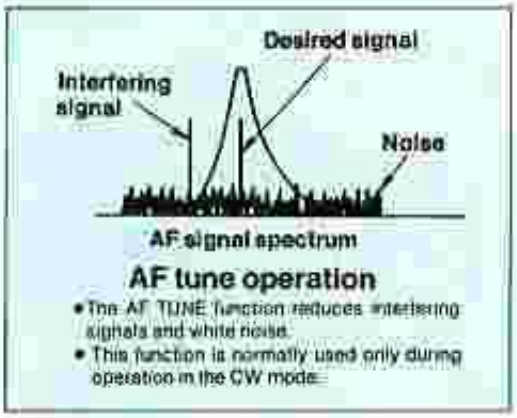
The TS-940S incorporates a number of special interference control circuits perfected by TRIO and described in the following paragraphs that give the operator maximum capability to minimize the effect of interference of all kinds.

(1.) SSB IF Slope Tuning.

This feature operates in the LSB and USB modes. Front panel controls are provided to allow independent adjustment of either the low frequency or high frequency slopes of the IF passband. These HIGH CUT and LOW CUT controls permit the operator to easily and quickly define the most ideal IF passband width consistent with

(2.)

(3.)



(5.) Narrow/Wide Filter Selection.
A front panel "NAR/WIDE" switch allows narrow/wide IF filter selection as required, based on interference conditions. The use of an 8.83 MHz 2nd IF, followed by a 455 kHz 3rd IF promotes excellent selectivity, with maximum potential for the use of various filter combinations to further enhance that important performance characteristic. The TS-940S comes with 2.7 kHz SSB filters (both 8.83 MHz and 455 kHz IF), and a 6 kHz AM filter (455 kHz IF), built-in. A selection of easily installed plug-in optional filters is available for the operator who requires maximum selectivity control.

W/N switch	WIDE		NARROW	
Mode	2nd IF filter	3rd IF filter	2nd IF filter	3rd IF filter
SSB	2.7 kHz*9	2.7 kHz*9	2.7 kHz*9	2.7 kHz*9
CW.FSK	2.7 kHz	2.7 kHz	0.5 kHz*1	0.5 kHz*3 or 0.25 kHz*4
AM	6 kHz*1	6 kHz	2.7 kHz	2.7 kHz
FM	Wide band	12 kHz	Wide band	12 kHz

*9: 2.7 kHz+2.7 kHz=2.4 kHz (Total selectivity)
*1: option YK-88A-1 installed
*3: option YK-88C-1 installed
*3: option YK-455C-1 installed
*4: option YK-455CN-1 installed

Built-In CW Variable Pitch Circuit.
The CW pitch control shifts the 4th IF passband in the demodulator circuit while, at the same time, raising or lowering the pitch of the audible beat frequency. This is very useful in avoiding interference or for changing the pitch tone to a frequency that is easier to copy, without moving the signal out of the IF filter pass band.

Dual-Mode Noise Blanker ("Pulse"

Built-in RIT/XIT.
The front panel "RIT" (Receiver Incremental Tuning)/"XIT" (Transmitter Incremental Tuning) control shifts the receive or transmit frequency in 10 Hz steps across a range of ±9.99 kHz, using an optical encoder, to tune stations that are slightly off frequency, and without affecting the VFO transmit/receive frequency. RIT/XIT frequency shifts (0.0~±9.99 kHz) are displayed in the main display area. A "CLEAR" switch resets the RIT/XIT frequency to zero. The "RIT/XIT" control may be used in any mode of operation.

All-Mode Squelch Circuit.
The squelch circuit is effective in suppressing background noise in all operating modes.

RF Attenuator.
The meticulously engineered receiver section front end includes a 4-step, 0, 10, 20, or 30 dB RF attenuator, for optimum rejection of intermodulation distortion.

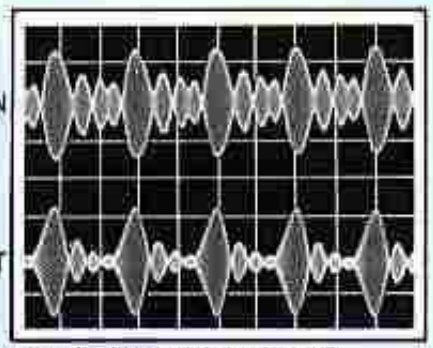
Switchable AGC Circuit (OFF/FAST/SLOW).
The automatic gain control (AGC) is activated by a 3-position (OFF/FAST/SLOW) switch, to provide optimum receiver operation in all modes, and under all signal strength conditions.

AUTOMATIC ANTENNA TUNER PLUS LOW DISTORTION, HIGH RELIABILITY TRANSMISSION

Automatic Antenna Tuner (160-10 metres) Built-In.
The TS-940S is available with a completely automatic antenna tuner covering all Amateur bands from 160 through 10 metres built-in, or may be ordered without the tuner installed. An AT-940 antenna tuner is available for future installation in transceivers initially ordered without the tuner. With the "AUTO/THRU" switch in the "AUTO" position, depressing the "AT.T" key sets up the automatic tune condition, which lasts for approximately 3 seconds. The LCD sub-display reads "ANTENNA TUNER AUTO-TUNE READY." Keying the transmitter while this message is being displayed initiates automatic tuning at the 50 watt RF output level, using high speed motors to reduce the tuning time. During the tuning cycle, the LCD sub-display indicates "ANTENNA TUNER TUNING . . .!" When the

Built-in Speech Processor.

The TS-940S employs speech processing circuitry based on RF clipping techniques. A marked improvement in the intelligibility threshold is attainable, depending on the positions of separate front panel "IN" and "OUT" controls. A higher average "talkpower" plus improved intelligibility makes for outstanding DX performance.



(Approx. 10 dB compression)

RF Output Power Control.

Using a front panel control, the RF output power may be continuously varied from 10 watts to the maximum power, in any mode of operation.

OPERATING FREQUENCY CONTROL USING NEW MICROPROCESSOR PLUS DIGITAL TECHNOLOGY.

The use of a new microprocessor plus advanced digital technology to control the various tuning functions, including the 2 digital VFO's, the 40 channels of memory, band scan and memory scan, etc., assures maximum flexibility and ease of operation under the most difficult operating conditions.

10 Hz Step Dual Digital VFO's with Optical Encoder.

Special tuning logic, working in conjunction with the basic 10 Hz step, high stability digital VFO design, provides a variable speed tuning characteristic that is directly related to the speed of tuning knob rotation. A large, die-cast tuning knob with moulded rubber cover, rotated at normal tuning speeds, results in a frequency shift in 10 Hz increments, or 10 kHz per tuning knob revolution. Rotation of the tuning control at speeds in excess of approximately 2 to 3 revolutions per second causes the tuning

40 Memory Channels.

For operating purposes, the 40 memory channels are divided into 4 groups of 10 channels each. Both mode and frequency data are stored, making all operations simple and convenient. The operator may select any 1 of the 4 memory groups for operations, using the 4 position memory bank switch located on the top panel. Depressing the "VFO/M" switch on the front panel permits selection of the memory channel, using the 10 band keys. The "M▶VFO" switch is used to transfer memory data (frequency and mode) to the active VFO. Memory information is backed-up by an internal lithium battery. (Est. 5 yr. life.)

Built-in Scan Functions.

Memory scan is initiated by depressing the "MS" switch. Memories in which no data is stored are skipped. Programmable band scan is initiated by depressing the "PG.S" switch, and scans in 10 Hz (100 Hz in AM, FM modes) steps from the lowest frequency within the frequency limits specified in memory channels "9" and "0". A "HOLD" switch is provided to interrupt the scanning process during memory and program scan operations. When the "HOLD" switch has been depressed during program scan, the VFO operating frequency may be adjusted within the frequency limits established in memory channels "9" and "0".

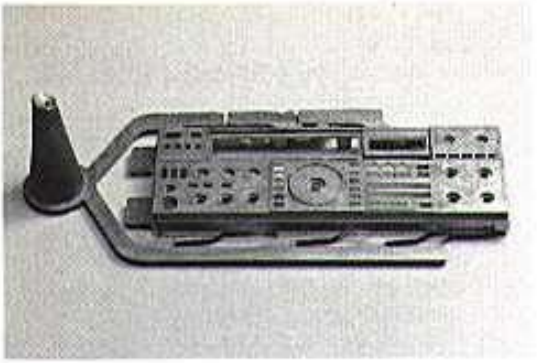
Rapid Band Selection.

A specific Amateur band may be quickly selected by depressing the appropriate front panel band key. One MHz step "UP" and "DOWN" switches on the front panel allow rapid selection of shortwave broadcast frequencies. An "F.LOCK" switch prevents accidental loss of the selected frequency.

Direct keyboard entry of frequency

The dual function band selection keyboard is also used for direct entry of any frequency within the operating range of the TS-940S. Touching the ENT button transfers the TS-940S into direct entry mode. Any frequency can then be keyed into the main display, and a second touch of the ENT button, transfers this frequency into the operating VFO. The main tuning knob can then tune up or down from the entered frequency if required.

MULTI-FUNCTION MAIN DISPLAY AND SUB-DISPLAY.



Efficent Cooling System Allows 100% Transmit Duty Cycle.

The 100 W final amplifier stage is mounted directly on its die-cast aluminum heat sink and by using a ducted air-flow cooling system, provides maximum thermal conduction efficiency. The high efficiency of the cooling system permits continuous transmission at full power for periods of approximately one hour without thermal shut-down.

The power supply unit has its own independent cooling system and fan, also incorporating the ducted air-flow concept.

A VARIETY OF EXTRA, EASY-TO-OPERATE FUNCTIONS.

Built-in AC Power Supply and Speaker.

The TS-940S is a self-contained HF station, including a built-in power supply, and a rugged, top-mounted, high quality, 10 cm (4 inch) speaker. The power supply circuit provides ample capacity by use of a special, compact, laminated core transformer, assuring maximum stability of operation of the final transistor circuits. The correct AC circuit polarity is achieved through use of the 3-wire connector and cable assembly supplied with the unit.

Clock/Timer Function.

In addition to a 24-hour clock function, a single event timer is provided for scheduled un-attended recording of a specified transmission. Clock/Timer program data may be displayed on the LCD sub-display at the operator's option.

Transmission Monitor Circuit.

A built-in transmit monitor circuit operating in the SSB, FM, and FSK modes may be operator activated by depressing the front panel "MONI" switch. This circuit monitors the product detector signal from the output of the IF section during transmission, allowing the operator to check his audio quality, and the effectiveness of the speech processor.

High Stability RTTY Transmit Circuit.

The stability of RTTY transmissions is greatly improved through design that obtains the FSK signal information from the reference oscillator. The FSK shift width is 170 Hz.

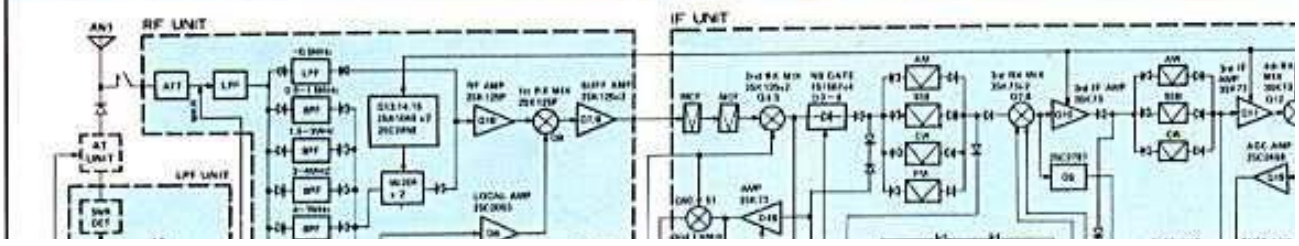
Voice Synthesiser Unit (Optional).

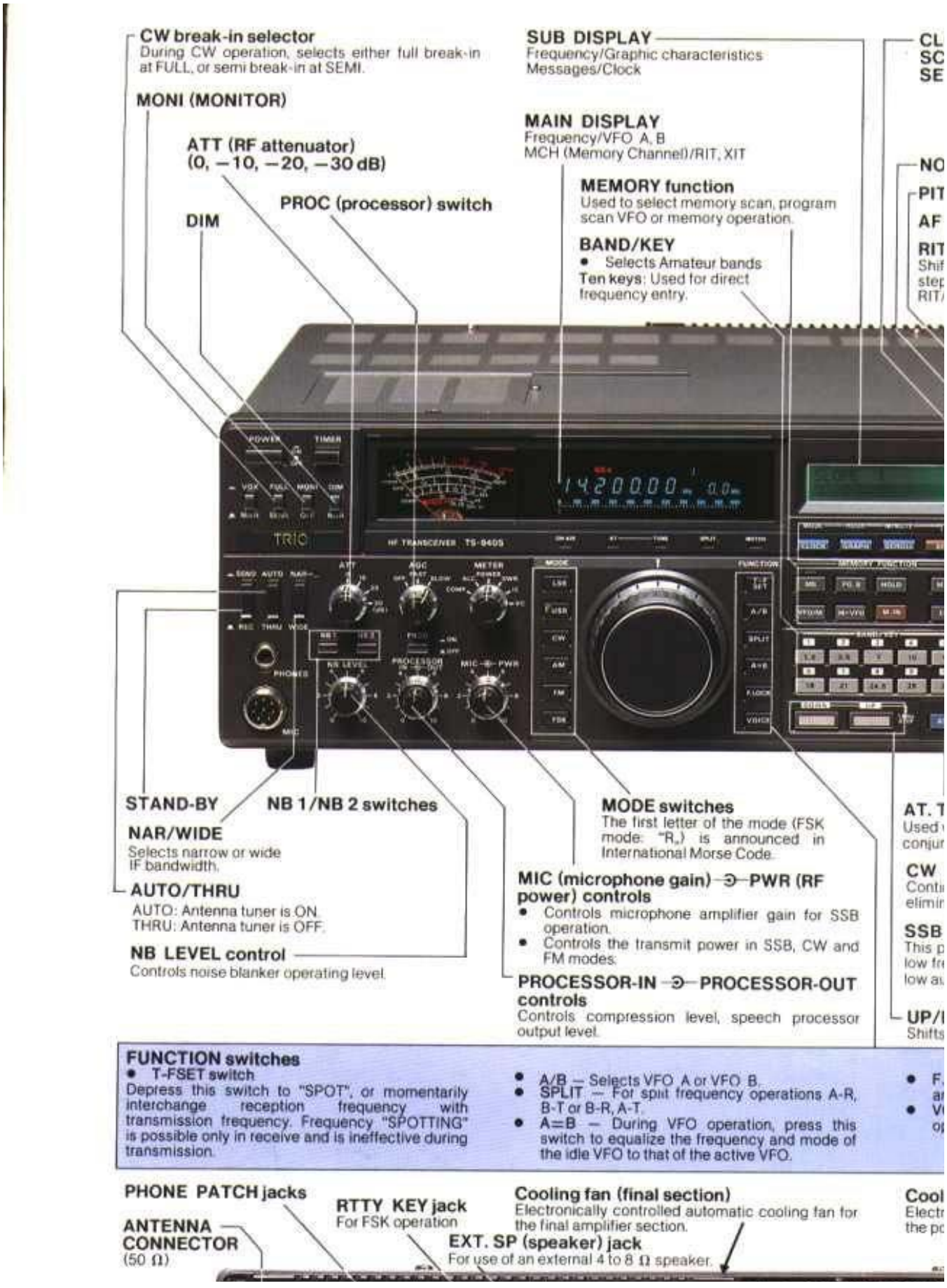
An optional VS-1 "Voice Synthesiser Unit", which announces the operating frequency on demand by depression of the front panel "VOICE" key, is available. Installation within the cabinet is simple and easy.

Optional SO-1 TCXO "Temperature Compensated Crystal Oscillator".

An optional, high-stability TCXO, model SO-1, may be installed in place of the reference oscillator. This unit operates at a frequency of 20 MHz and has a thermal stability of $\pm 5 \times 10^{-7}$.

TS-940S BLOCK DIAGRAM

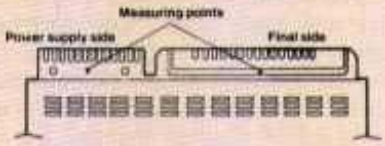


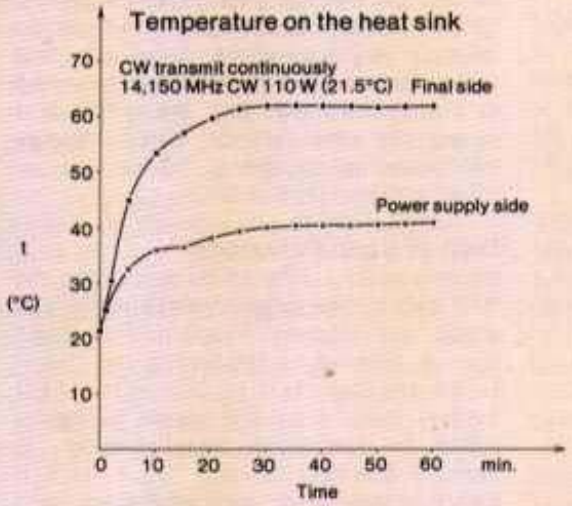

CW break-in selector
During CW operation, selects either full break-in at FULL, or semi break-in at SEMI.
MONI (MONITOR)
ATT (RF attenuator) (0, −10, −20, −30 dB)
PROC (processor) switch
DIM
SUB DISPLAY
Frequency/Graphic characteristics Messages/Clock
MAIN DISPLAY
Frequency/VFO A, B
MCH (Memory Channel)/RIT, XIT
MEMORY function
Used to select memory scan, program scan VFO or memory operation.
BAND/KEY
• Selects Amateur bands
Ten keys: Used for direct frequency entry.
STAND-BY
NB 1/NB 2 switches
NAR/WIDE
Selects narrow or wide IF bandwidth.
AUTO/THRU
AUTO: Antenna tuner is ON.
THRU: Antenna tuner is OFF.
NB LEVEL control
Controls noise blanker operating level.
MODE switches
The first letter of the mode (FSK mode: "R") is announced in International Morse Code.
MIC (microphone gain) ↔ PWR (RF power) controls
• Controls microphone amplifier gain for SSB operation.
• Controls the transmit power in SSB, CW and FM modes.
PROCESSOR-IN ↔ PROCESSOR-OUT controls
Controls compression level, speech processor output level.
FUNCTION switches
• T-FSET switch
Depress this switch to "SPOT", or momentarily interchange reception frequency with transmission frequency. Frequency "SPOTTING" is possible only in receive and is ineffective during transmission.
• A/B — Selects VFO A or VFO B.
• SPLIT — For split frequency operations A-R, B-T or B-R, A-T.
• A=B — During VFO operation, press this switch to equalize the frequency and mode of the idle VFO to that of the active VFO.
PHONE PATCH jacks
ANTENNA CONNECTOR (50 Ω)
RTTY KEY jack
For FSK operation
Cooling fan (final section)
Electronically controlled automatic cooling fan for the final amplifier section.
EXT. SP (speaker) jack
For use of an external 4 to 8 Ω speaker.

Highly Efficient, Ducted Air-Flow, Cooling System

A new air distribution system allows operation on a 100% transmit duty cycle basis for periods of approximately one hour.

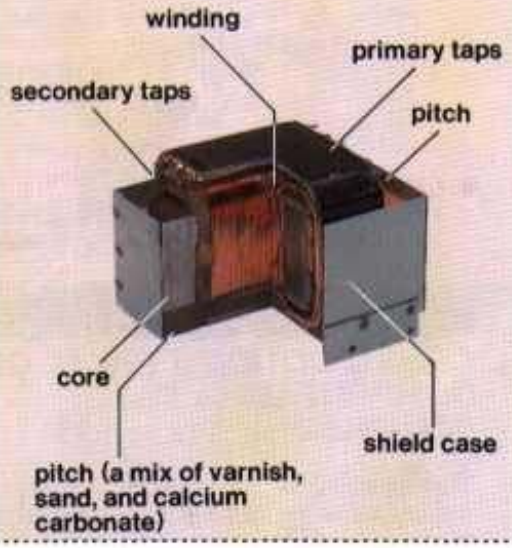
The heat sink cooling fins are designed to be an integral part of the ducted air-flow system, which is constructed in such a manner as to assure a continual flow of air across the front and rear surfaces of the heat sink, as well as over the fins themselves. Ports of varying sizes have been strategically located throughout the air-flow system to prevent dead-air pockets. Cooling air is drawn through the cabinet area by a quiet, two-speed fan that then directs its discharge air-flow into the ducting at a point immediately adjacent to the final amplifier transistors, assuring maximum heat transfer from these important components. Fan operation is controlled through use of automatic switching initiated by a detecting thermistor that senses final amplifier temperature.





Laminated Core Transformer

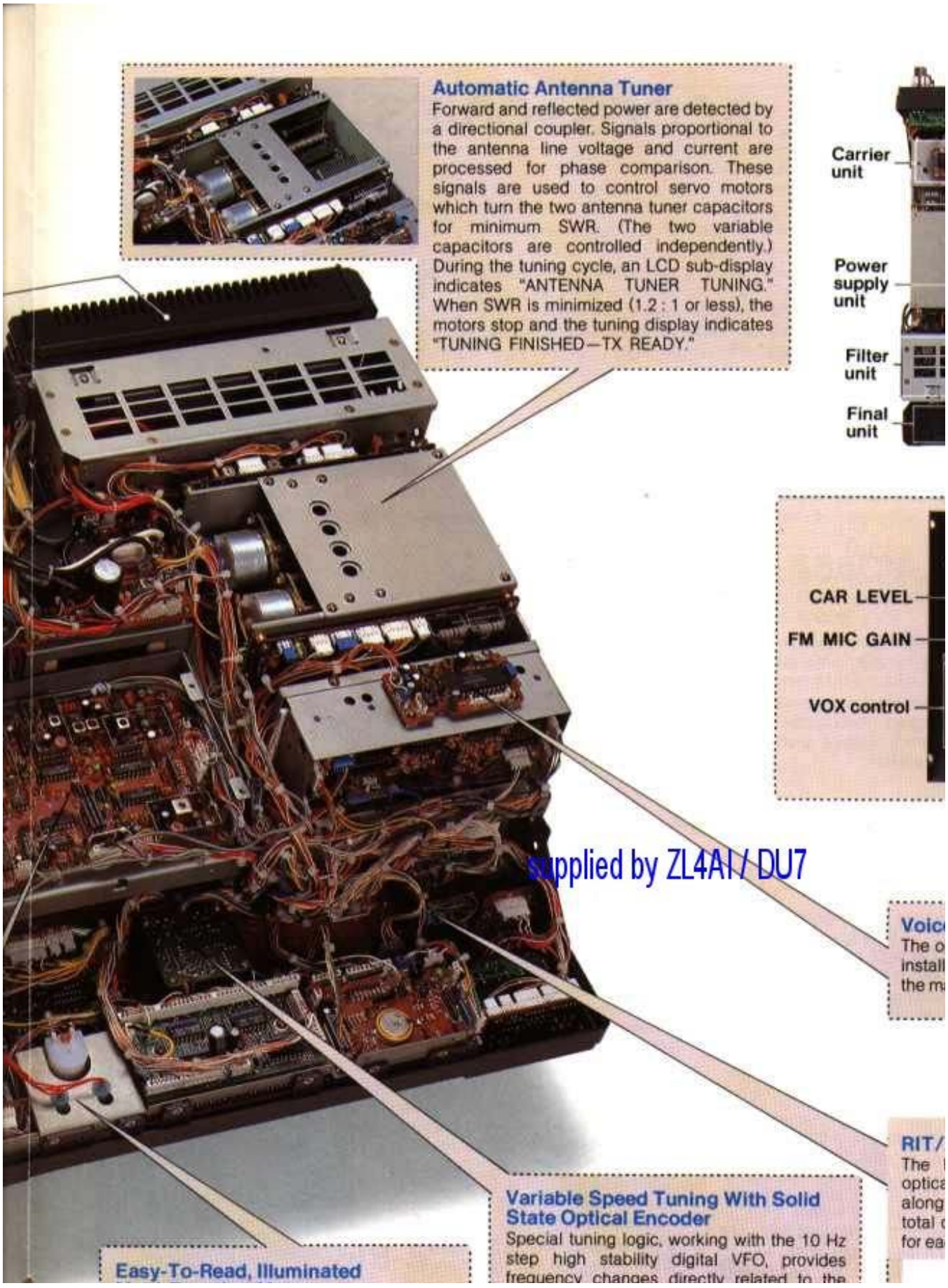
The power transformer is high performance, shielded, and potted to protect the windings and connections from vibration and impact damage.



Optional SO-1 TCXO Temperature Compensated Crystal Oscillator.

An optional, high-stability TCXO, model SO-1,

RF unit


Automatic Antenna Tuner
Forward and reflected power are detected by a directional coupler. Signals proportional to the antenna line voltage and current are processed for phase comparison. These signals are used to control servo motors which turn the two antenna tuner capacitors for minimum SWR. (The two variable capacitors are controlled independently.) During the tuning cycle, an LCD sub-display indicates "ANTENNA TUNER TUNING." When SWR is minimized (1.2 : 1 or less), the motors stop and the tuning display indicates "TUNING FINISHED—TX READY."
Carrier unit
Power supply unit
Filter unit
Final unit
CAR LEVEL
FM MIC GAIN
VOX control
supplied by ZL4AI / DU7
Variable Speed Tuning With Solid State Optical Encoder
Special tuning logic, working with the 10 Hz step high stability digital VFO, provides
Easy-To-Read, Illuminated

TS-940S OPTIONAL ACCESSORIES

SP-940

External Speaker

The SP-940 is a high class external speaker designed to match the TS-940S in size, colour and appearance. The SP-940 uses a panel made of reinforced ABS plastic and an expanded metal speaker grill to improve tone quality. It is a low-distortion speaker with selectable frequency response for high intelligibility in any mode. The frequency response is determined by the built-in audio filters, which are effective in improving signal-to-noise-ratio under certain interference conditions, or when receiving weak signals. On the front panel is a headphone connector, for listening to audio output passed through the filters. Also on the front panel is a switch for selecting either of two audio inputs to the SP-940.

SPECIFICATIONS

•Speaker Diameter: 100 mm (4 inch) •Input Power (max.): 1.5 W (3.0 W) •Impedance: 8 Ω •Frequency Response: 100 Hz—5 kHz •Filter Cut-off Frequency: LOW 430 Hz (—3 dB)/ HIGH1 1 kHz (—3 dB)/HIGH2 2.5 kHz (—3 dB)/ HIGH1 + HIGH2 730 Hz (—3 dB) •Filter Attenuation: —6 dB/OCT •Dimensions: 180 (7.01) W ×140 (5.51) H×290 (11.4) D mm (inch), (Projections not included) •Weight: 2 kg (4.41 lbs) approx.

AT-940

Automatic Antenna Tuner

The AT-940 is an optional automatic antenna tuner that can be installed in the TS-940S.

FEATURES

- Full coverage of 160 through 10 meters, including the new WARC bands.
- Automatic motor speed control. The motor automatically stops when the SWR drops to its minimum value (1.2:1 or less).
- The AUTO-THRU circuit is disabled during transmission to protect the final transistors in case the AUTO-THRU switch is accidentally operated.
- The "tune" condition for automatic antenna tuning remains unchanged during transmission when the "AT.T" switch is depressed.

SPECIFICATIONS

•Frequency Range: All Amateur bands from 1.8 to 29.7 MHz •Input Impedance: 50 Ω unbalanced •Output Impedance: 20—150 Ω unbalanced •Insertion Loss: Less than 0.8 dB •Through Power: 150 W •Maximum Tuning Time: Less than 1

SM-220

Station Monitor

Based on a wide-frequency-range oscilloscope (up to 10 MHz), the SM-220 station monitor features, in combination with a built-in two-tone generator, a wide variety of waveform-observing capabilities. When the BS-8 is installed in the SM-220 and connected to the transceiver, signal conditions in the vicinity of the receive frequency can be viewed over a ±20 kHz or ±100 kHz range. The SM-220 provides efficient station operation as it monitors transmitted waveforms, and it also serves as a high-sensitivity, wide-frequency range oscilloscope for various adjustments and experiments.

SPECIFICATIONS

(Transmit Signal Monitor Terminal) •Frequency range: 1.8—150 MHz •Maximum power: 1 kW (1.8—54 MHz), 50 W (150 MHz) •SWR: 1.2:1 or less •Deflection sensitivity: Better than 1 div. at 2 W input •Attenuator: 6 steps **(Trapezoid waveform observation)** •Frequency range: 1.8—30 MHz •Maximum power at DRIVE TERMINAL: 2—100 W •SWR: 1.2:1 or less **(Two-tone generator)** •Oscillator frequency: 1,000 Hz and 1,575 Hz •Output voltage: 10 mV/50 kΩ (at TWO TONE) **(Pan display unit)** •Input centre frequency: 8.830 MHz •IF frequency: 455 kHz •IF bandwidth: DC—250 kHz or over (EXT GAIN a •Input resistance/capacitance: 1 M at INT) •Attenuator: Fully variabl **(Sweep circuit)** •Sweep frequen adjustment) •Sweep linearity: Bette sweep, internal negative sync and e Better than 1 div. on CRT, External; •Deflection sensitivity: Better thar Hz—10 MHz (—3 dB) •Input re •Overshoot: Less than 5% •Attenu (Error between steps: 5% max.) •Max. input voltage: 300 V (DC+AC peak) or 600 Vp-p •Power supply: 120/220/240 V AC±10%, 50/60 Hz 20 W •Dimensions: 215 (8.6) W×153 (6.1) H×335 (13.4) D mm (inch) •Weight: 5 kg (11 lbs.)

OPTIONAL ACCESSORIES

•BS-8...Pan Display for TS-830S/

SW-200A, 2000

SWR/POWER Meter (supplied with a coupler)

SW-200A supplied with SWC-1
SW-2000 supplied with SWC-3
Selectable Peak-reading/RMS, SWR/POWER meters for base station use.

SPECIFICATIONS

•Impedance: 50~52Ω •Frequency range: 1.8~150 MHz (SW-200A) 1.8~54 MHz (SW-2000) •Power measuring range: 0~20/200 W (SW-200A) 0~200/2000 W (SW-2000) •Accuracy: Less than ±10% of full scale

•Sensitivity: Less than 20W
•Dimensions: 193 (7.6) W×6
0.7 kg (1.5 lbs.) approx.

YK-88A-1

6 kHz AM Filter for 8.83 MHz IF

•Centre Frequency: 8830.0 kHz •Selectivity: 6 kHz (−6 dB), 11 kHz (−60 dB)
•Guaranteed Attenuation: More than 80 dB

YK-88C-1

500 Hz CW Filter for 8.83

•Centre Frequency: 8830.0 k
500 Hz (−6 dB), 1.5 kHz (−60
•Guaranteed Attenuation: More

YG-455C-1

500 Hz CW Filter for 455 kHz IF

•Centre Frequency: 455.0 kHz •Selectivity: 500 Hz (−6 dB), 820 Hz (−60 dB)
•Guaranteed Attenuation: More than 80 dB

YG-455CN-1

250 Hz CW Narrow Filter fo for 455 kHz IF

•Centre Frequency: 455.0 kH
250 Hz (−6 dB), 480 Hz (−60 d
•Guaranteed Attenuation: More

SO-1

Superior Stability TCXO (Temperature compensated crystal oscillator)

(Requires modifications)
•Frequency Oscillator: 20 MHz •Frequency Stability: $\pm 5 \times 10^{-7}$ (−10°C~+50°C) •Frequency Correct Range: Better than ±60 Hz

VS-1

Voice Sy

MC-42S (500 Ω)

UP/DOWN Hand Microphone (8 pin)

The MC-42S is a handy dynamic microphone with PTT switch and UP/DOWN switches.

MC-60A (50 kΩ/50

Deluxe Desk-Top Microph Preamplifier (8 pin)

The zinc die-cast base provide the MC-60A is completed wi switches, UP/DOWN switche selector switch and a built-in pre

MC-85 (700 Ω)

Multi-function Desk-Top Microphone with built-in Audio Level Compensation (8 pin)

The MC-85 is an unidirectional high-class electret condenser microphone provided with an output select switch, audio level compensation circuit, low cut filter, level meter, PTT and LOCK switch.

MC-80 (700 Ω)

Desk-Top Microphone Preamplifier (8 pin)

The MC-80 is an omnidire condenser microphone p UP/DOWN switch, volume adjus level, PTT and LOCK switc pre-amplifier.

HS-4 HS-5 HS-6

TS-940S SPECIFICATIONS

[GENERAL]

Transmitter
Frequency Range ..... 160-m band 1.8—2.0 MHz
80-m band 3.5—4.0 MHz
40-m band 7.0—7.3 MHz
30-m band 10.1—10.15 MHz
20-m band 14.0—14.35 MHz
17-m band 18.068—18.168 MHz
15-m band 21.0—21.45 MHz
12-m band 24.89—24.99 MHz
10-m band 28.0—29.7 MHz

Receiver Frequency Range ..... 150 kHz—30 MHz
Mode ..... A3J (USB, LSB), A1 (CW) F1 (FSK), F3 (FM), A3 (AM)
Frequency Stability ... $\pm 10 \times 10^{-6}$ (—10°C—+50°C)
Frequency Accuracy .. $\pm 10 \times 10^{-6}$ (at normal temperatures)
Antenna Impedance ... 50 Ω (20—150 Ω with the AT-940 antenna tuner installed, transmission only)
Power Requirements .. 120/220/240 VAC, 50/60 Hz
Power Consumption .. Max. transmit 510 W
Receive (no signal) 80 W
Dimensions ..... 401 (15.79) W × 141 (5.55) H × 350 (13.78) D mm (inch) (Projections not included)
Weight ..... 18.5 kg (40.78 lbs.) approx.
20 kg (44.09 lbs.) approx. (with antenna tuner)

[Transmitter]

Final Power Input ..... SSB/CW/FSK/FM=250 W PEP
AM=140 W
Modulation ..... SSB=Balanced Modulation
FM=Reactance Modulation
AM=Low Level Modulation

FM Maximum Frequency Deviation ..... ±5 kHz
FSK Shift Width ..... 170 Hz
Carrier Suppression .. Better than 40 dB

[Receiver]

Circuitry ..... SSB/CW/AM
FM: Triple c

Intermediate frequency ..... 1st IF 45
2nd IF 8
3rd IF 45
4th IF 1(

Sensitivity ..... at 10 dB (S/

Mode \ Frequency	150—500 kHz	5
SSB, CW, FSK	Less than 1 μV	
AM	Less than 10 μV	
FM (SINAD 12 dB)	—	

Squelch Sensitivity ... Less than —
Image Ratio ..... More than 8
IF Rejection ..... More than 7
Selectivity ..... SSB, CW, A
2.4 kHz (
3.6 kHz (
AM (Wide)
6 kHz (—
15 kHz (
FM
12 kHz (
22 kHz (

Variable Frequency Range ..... SSB slope t
High-cut
Low-cut
CW VBT (w

RECEIVER PERFORMANCE IMPROVEMENTS.

R1. KENWOOD PRODUCED 3 SERVICES BULLETINS which do considerably improve the receiver.

AGC circuit improvement

http://www.kenwood.net/indexKenwood.cfm?
do=DownloadFile&Document=2d13f766bec08d9297b46280e3758b9b95e42da53ae01ebf6db6adb98b2ed832baa0aa033a297c

http://www.kenwood.net/indexKenwood.cfm?
do=DownloadFile&Document=d02a8b1ae4c8a39115ff83f169f65a1895e42da53ae01ebf6db6adb98b2ed832baa0aa033a297d1

TS-940S Signal To Noise Ratio Improvement With Noise Blanker
http://www.kenwood.net/indexKenwood.cfm?
do=DownloadFile&Document=09b9d746891ed0281dcc8482861e53da08bf66aab282a3fe0ec52cce1a1412bab3177362513310

TS-940S VCO/Carrier To Noise Ratio Improvements
http://www.kenwood.net/indexKenwood.cfm?
do=DownloadFile&Document=57aa76a9447b3b37e1e9f60965f865a395e42da53ae01ebf6db6adb98b2ed832baa0aa033a297d

http://www.kenwood.net/indexKenwood.cfm?
do=DownloadFile&Document=2e0ca5ad0e0e9060f7f850fe27f80b1a95e42da53ae01ebf6db6adb98b2ed832baa0aa033a297d1

http://www.kenwood.net/indexKenwood.cfm?
do=DownloadFile&Document=55221dd570b7e465e5087cf67f5e71fa95e42da53ae01ebf6db6adb98b2ed832baa0aa033a297d1

KENWOOD TS-940S RECIPROCAL MIXING NOISE
In early March I [Rich Maher] talked to someone at International Radio regarding the reciprocal mixing noise problem with the Kenwood TS-940S. I had been in the process of installing the fix described in your newsletter (late 1986 issue) and found that it had already been installed on my TS-940S (S/N 7100269). The factory installation had one problem, the resistors used for R120/R129 were color coded for 900 ohm (close enough to the 1K in the newsletter), but in actuality measured 465 ohms. Apparently, Kenwood had gotten a bad batch of resistors from some supplier and had not discovered the problem.

At the time you indicated that was the first report you had received of the resistor value problem and recommended that I contact Kenwood. I called them and was told that they had not heard of the problem before. They also stated that a new fix for the reciprocal mixing noise problem had been developed and

was described in a Service Bulletin dated March 2, l987. I requested a copy of the bulletin and have attached a copy of it to this letter for your information. (See Issue No. 76, Pg. 30 and 31 for Kenwood Service Bulletin No. 917 and schematics pertaining to this subject.)

Since receiving the bulletin from Kenwood, I have installed it on my TS-940S and found it to make a very significant improvement in weak signal handling in the presence of nearby strong signals. I would recommend highly that anyone experiencing reciprocal mixing problems install the new fix. It should be noted that some of the newer TS-940S have the fix installed. I was preparing to install the fix on a friends's TS-940 which had a serial number 100 lower than my own and found that the fix had been factory installed. Apparently, more than one manufacturing site is used and serial numbers are given to each in blocks. Consequently, it is possible for higher serial numbers to be produced at one location without the fix, while another site any have cut in the fix but is using numbers from a lower block.

The quickest way to verify whether the fix has been installed is to check R120 and R129 on the PLL Unit (X50-2020-00). If these two resistors are 3.3 ohms in value [*Editor correction Service Bulleting 917 says 3.3 Kilo-Ohms*], the fix is already installed. Do not depend on the on the absence of C176, C180 or C181 as an indication, as earlier attempts (factory or field) to correct the mixing noise problem may have removed these same capacitors. The instructions in the bulletin state that when making the modifications to the RF Unit (X44- 1660-00), it is easiest to move C132/C133 to the foil side of the board. As the component side of the section of the RF Unit containing these two capacitors has been filled with wax, it is definitely not easier. The factory installation of the fix left C132/C133 on the component side and installed the R154/C193 and R155/C194 series RC networks on the foil side. This is definitely easier. As a side note, the installation of the fix took me about 2 hours. Both the PLL Unit and RF Unit modifications must be completed before the transceiver is usable. If you install just the PLL Unit modifications and then try the receiver, CW signals will should like raw AC. Also, to make life simple, do not remove each of the boards above the PLL Unit individually. The easy way to gain access to the PLL Unit is to remove the top two screws (one on each side) holding the front panel and loosen the bottom tow screws. This allows the front panel to be tilted forward. The speaker assembly and all the boards above the PLL unit may then be removed as a unit by removing only 4 screws and tilting this unit towards the front of the TS-940S. No cables need be removed from the boards above the PLL Unit.

I hope the above information is helpful to you in dealing
with the reciprocal mixing noise problem. (Thanks, Rich
Maher, WZ4Z, 1117 NW 7th St., Boynton Beach, FL 33435)

RECEIVER 2. FIELD EFFECT TRANSISTORS AROUND THE WRONG WAY.

In September 2004 PY1NR announced he had discovered:

-on RF board Preamp Q10 and

-on the IF board 2nd balanced mixer Q4,

had been drawn on the circuit boards and mounted in the reverse orientation to that shown in the Kenwood Circuit Diagram.

See PY1NR web site www.guisard.com
and

http://www.eham.net/articles/9261

Initially ZL4AI found it hard to understand this website and actually what PY1NR had discovered. Starting with the circuit board layouts I tried to draw out the circuit: What I found was that apparently the FETS were mounted with the drain where the source was supposed to be and vice-versa.

As FETs normally allow current flow until the gate has a potential, I wonder if this really makes that much difference.

PY1NR suggest that reversing these transistors will provide 10 dB of gain. But this claim does not appear be based on before and after measurement. It would be useful to have some feedback on whether others have had much improvement by reversing the FETS.

Garey Barrell provides Kenwood's advice

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==========================================================
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From: kenwood-bounces@mailman.qth.net [mailto:kenwood-bounces@mailman.qth.net] On
Behalf Of Garey Barrell
Sent: Wednesday, 9 March 20055:53 a.m.
To: Kenwood@mailman.qth.net
Subject: Re: [Kenwood] RE:TS-940 What is the correct FET direction?
Jeff -
OK.....  Just in from Kenwood...
++++++++++++++++++++++++++++++++++++++++++++++++++++
Dear Kenwood Customer:
This information pertains to the TS-940S component location.
The circuit designer said the installation of Q10 in the actual TS-940S transceiver
is correct.
The PCB view in the Service Manual is correct too. The schematic is the only
section that is in error. The schematic indicates the drain of one FET connected to
the source of the second FET. The correct installation is to have the source of one
FET connected to the source of the second FET.
In addition, testing at Kenwood Communications in Long Beach, CA showed poor
results. Sensitivity can become unstable. The most important point about the Q10
pair is that both FET's must be replaced at the same time (like a matched pair).
Replacing only one FET at a time can affect sensitivity.
If you need further assistance, please e-mail us again.
Sincerely,
Kenwood Amateur Radio Customer Support
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
73, Garey - K4OAH
Atlanta
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From: Garey Barrell [k4oah@mindspring.com]
Sent: Friday, 11 March 2005 7:26 a.m.
To: jaking@es.co.nz
Subject: Re: [Kenwood] RE:TS-940 What is the correct FET direction?

Jeff -

OK. I just had a discussion via phone with the Amateur service department at Kenwood.

The Q4 situation is not quite as clear. The schematic appears to be correct, (sources tied together or push-pull,) and the board layout
drawing appears to be incorrect. According to a tech in Japan, the FET's in the actual unit are correct. They have not found any instance where they were reversed in the actual radio or any 'in-house' docs that could have resulted in such an error. *I guess someone is going to have to open one up and look at the traces! Looking at the board traces in the component layout, it certainly appears that one FET has the Source and Drain connections reversed if the FETs are installed in the orientation shown. Perhaps the board traces were changed? [ZL4AI editor comment: Boards made exactly as shown in the Service Manual]*

The guys at Kenwood, both in LA and Japan, are pretty frustrated with the whole mess! They tried to duplicate the Q10 situation, and found that performance was degraded considerably when the PY1 "correction" was made. They also mentioned that replacing one of the pair was not recommended. The original circuit used a matched pair and they recommended replacing them only with a matched pair. They were unable to describe the "matching" process, but we surmised they selected for Idss, and possibly transconductance.

The big question is, these transceivers have been working and meeting specs for 15+ years, so who cares!? :-)

73, Garey - K4OAH
Atlanta
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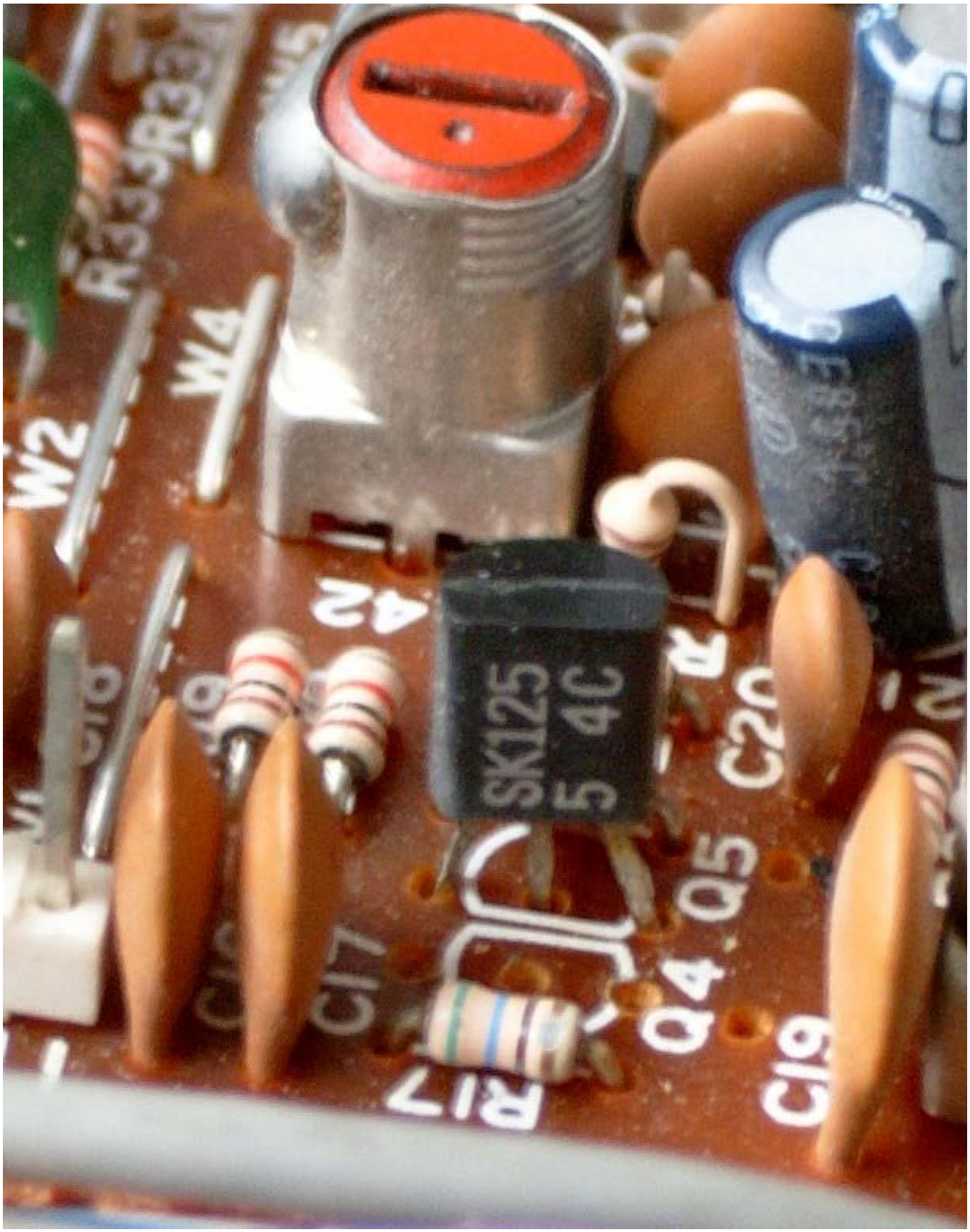
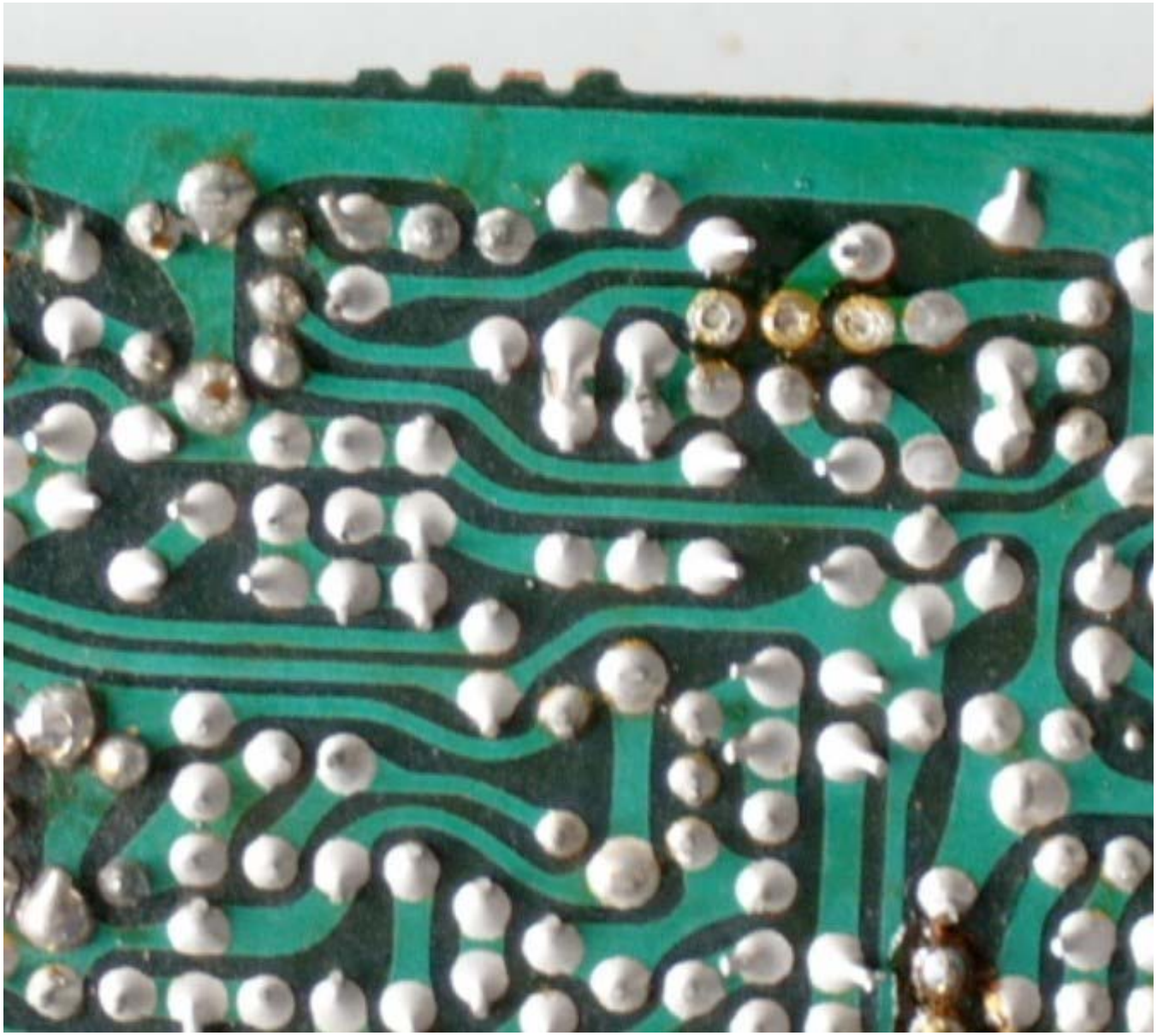
-----Original Message-----
From: Traian Belinas [mailto:traian@deck.ro]
Sent: Tuesday, 5 April 2005 9:34 p.m.
To: jaking@es.co.nz
Subject: Re: Ts-940 All problems SOLVED .. Possibly for you too!

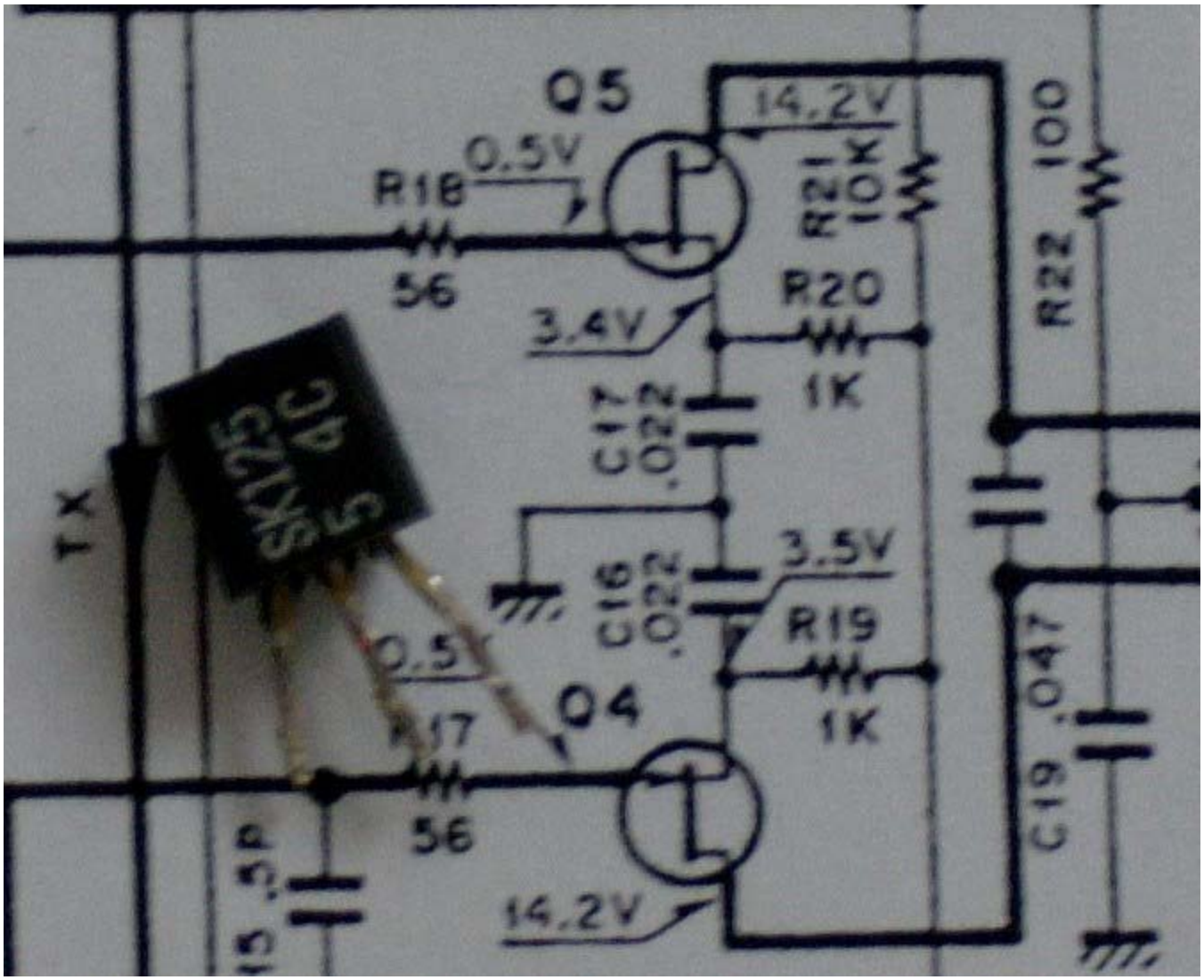
Hi Jeff,

The website is and will be great.
Will look carefully at.

I have two things to say.
First is that the second mixer Q4 JFET is indeed wrong mounted.
Here are attached pictures, you can use them on the website.
The PCB traces are symmetrical, the mixer should be balanced, and as the two
FETs are identical type, the way that they are mounted is obviously wrong.
As I said, I have reversed the Q4 and the improvement exist, but it is not
so great as other had reported (the sensitivity goes improved by 2 to 3 dB)


W2
W4
SK125
5 4C
Q4
Q5
R17
C19





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After reading Kenwood's Garey's and Traian's advice, I turned around only Q4 on the IF board. The result was a quieter receiver. I do not believe that there was any significant gain increase in the receiver.
I would appreciate (and will post on this page) emails describing others experience regarding this change.

From Kenwood.net on 25/4/05

Hi Dale

I also became interested in the RX mod you mention. Before opening my 940, I decided to first check whether drain and source of the 2SK125 are symmetrical or not. This was easy for me because I own a "dead" 940 RF board as a source of parts

for future repair of my rig.

I collected one of the 2SK125s from this board and built a source-grounded test configuration with a 5K resistor connecting drain to +8V. Then, I fed a sawtooth test signal (about -6 to -1V) via 10K into the gate. U(drain) was recorded against U(gate) on a DSO (Tek 468). Thereafter, I repeated the measurement with drain and source exchanged.

I obtained the characteristical FET response curves and these were exactly (!) identical in both configurations. This did not change when the test frequency was increased to 10 MHz. It seems, therefore, that the 2SK125 is symmetrical.

As a consequence, i decided not to correct the layout error in my 940.

Like others, I also believe that there is not much to improve. My 940 has an RX sensitivity of about 0.15 µV (10 dB S/N) on all bands (well, I must say it was worse until I re-aligned the entire RX). The IP3 is +18 dBm (I once replaced the band switching diodes by PIN diodes).

Like others, I often had connector problems after working in the 940 - another reason only to go into this rig when necessary.

Best 73,
Thomas (DF5KF)

THEN TRAIAN PROVIDES MORE OVERVIEW

-----Original Message-----
From: Traian Belinas [mailto:traian@deck.ro]
Sent: Friday, 29 April 2005 2:05 a.m.
To: jaking@es.co.nz
Subject: Re: FW: ts-940

Regarding the TS940 2SK125 preamp, yes the FETs have this interesting feature: for low signal/low freq and/or low DC, they are symmetric. This is why they are used as passive variable low resistance/attenuator/switching for low signal with rather good results. The things are changing at HF/VHF amplifiers where the interelectrode capacitances became important (do you remember about neutralising a FET preamp?), and these are not quite symmetrical, as the devices are manufactured so that the drain to gate capacitance to be as low as possible for obtaining lower out to in feedback when used for common source applications... So, even if symmetrical, why to use it as for having the greatest unwanted out ot in capacitance/feedback? The gain obtained by inverting the D/S for the TS940 Q10 may be still not high (I don't intend to do it because of the reason explained before), but the engineering feel tell us that something is not ok there... And regarding the second mixer, there it is obvious that it is not ok, even if it works... An counterexample is also the TS950 (both SD and SDX) which use the same Rx preamp as the TS940 with 2SK125 and 2SK520 (they are all FET cascade preamps) but for the 950 it is actually build as shown in the diagram, no drain/source inverting there (maybe the same for their second mixer), so which of them is the best regarding this, the 940 or the 950?!

Please let me know if any other new info about the 940/950.

Tnx,
73,
Traian

PY1NR provides feedback and re-endorses previous statements on turning the FETs around
PY1NRFeedback

From: ts-940@yahoogroups.com [mailto:ts-940@yahoogroups.com] On Behalf Of John Rotondi
Sent: Friday, 17 March 2006 10:51 p.m.
To: ts-940@yahoogroups.com
Subject: [ts-940] FET Reversal Fix Notes

Dear Fellow TS-940 users-

Just a quick post to let others know this information, which you can use as you see fit:

I have now fixed 2 TS-940SATs according to the findings of PY1NR who first detailed the reversal of 2 FETs in the TS-940, based on factory mistakes in the PCB silk-screening. After doing my own radio, I absolutely found a significant increase in received signal levels, with no audible increase in noise floor. I wondered why other users were not rushing to do the fix- and then saw several posts denying the validity of the fix. However, since I did not effectively document this in a scientific manner, I could not effectively offer valid 'proof' of the results.

When I mentioned this to one of my RACES group leaders- who also owns a TS-940- he decided that we would to do the 'fix' to his unit- but this time, we would document the results using a repeatable local test signal. The documented results: after each FET was reversed, we found a 1 S-unit improvement in received signal level using our local test signal in the 20 meter band, for a total of 2 S-units receive gain improvement.

Now, there is much conjecture regarding the dB value of S-units, and other TS-940 users may know what these 2 S-units on the TS-940 meter mean in terms of dB. Generally, from my research, each S-unit may represent 5 or 6 dB of signal, which means the fix has increased receive gain 10 to 12 db. Certainly nothing to sneeze at: being able to give one of the finest receivers made the full scope of RF gain that it was originally intended to have
- at no cost, and without negative repercussions? As the bands wane on the downside of the sunspot cycle, and running only a vertical 10 feet off the ground, I am finding I can use all the noise-free gain available to hear DX!

At any rate, this was my experience, which I humbly offer to the TS-940 user community.

Wishing you all good DX!
73,
John, WA2OOB
Ventura, CA

On Mar 19, 2006, at 1:53 AM, Jeff King wrote:

John,
found your report very very interesting.

Despite all the controversy, some of which I have reported on
http://homepages.ihug.co.nz/~jaking/TS-940_02.htm

I would appreciate if you could you please confirm you turned one FET around, ran signal test, identified improvement 1 S unit and then Turned other FET around and ran signal test, identified improvement 1 S unit?

You know it would be helpful if Kenwood would actually confirm their view of whether the FET in correct position results in too much gain.

hope to work you one day! and
73s
Yours sincerely
Jeff King zl4ai

From: John Rotondi, WA2OOB [mailto:wa2oob@earthlink.net]
Sent: Sunday, 19 March 2006 11:56 p.m.
To: jaking@es.co.nz
Subject: Re: [ts-940] FET Reversal Fix Notes

Hello Jeff!

Very nice to hear from you! Thank you for your interest in my posting on this topic.

I have seen your excellent website- thank you for providing such valuable information to the user community. I am still reading through
all the information regarding PIN diodes, and may mod my radio in that area as well.

Just a bit on my background: I am a professional sound engineer, and have been designing/building/maintaining/operating professional music
recording and TV/Film post production facilities for many years. When I first did the FET fix to my TS-940, the results were obvious to my
ears. In doing the second radio with my friend, we systematically followed these steps to document the results relative to an external repeatable test signal, independent of band conditions, QSB, etc.:

1) Set up the signal source: my MFJ-259 antenna analyzer with whip antenna, to generate a signal near 14.200 MHz.
2) Set up the TS-940 with a small whip antenna on the work table, about 4 feet from the test source. Note that the MFJ-259 RF test signal is fixed in level, so this would not be a variable in these tests.
3) Tuned the TS-940 to this test signal, peaking the carrier reception in USB mode, and recording the maximum S-meter reading.
Note that I moved the radio around a bit to ensure that the reading was stable and repeatable, and not sensitive to relative position.
4) Shut off the test source so as not to deplete the battery while working on the radio.
5) Reversed the first of the FETs, reinstalled it's PC board, installed the whip antenna, and positioned the radio as for the original measurement.
6) Powered up the test source, and tuned the TS-940 to it as before.
There was a full 1 S-unit increase in received signal level.
7) Shut off the test source.
8) Reversed the second of the FETs, reinstalled it's PC board, installed the whip antenna, and positioned the radio as for the original measurement.

9) Powered up the test source, and tuned the TS-940 to it as before.
There was now another full 1 S-unit increase in received signal level over the previous measurement, giving 2 full S-units total over the original base reading.

While this is probably not as sophisticated as if we would have used a Communications Monitor (IFR, Marconi, etc.) or other test system
directly coupled to the receiver, with stepped calibrated attenuators, and RF voltmeters coupled to the IF of the TS-940, we felt that it
would be a fast way to have valid empirical data to verify that we had created an improvement, rather than a disability, for the TS-940. BTW, post fix listening on air clearly showed the significant gain improvement.

In listening today on 10 meters on my own TS-940, I know that this additional gain has brought signals to the readable level that would
otherwise have not been readable. I have also done extensive listening tests with extremely strong local broadcast signals to determine if
this fix has compromised rejection of extraordinarily strong out-of-band signals, or has resulted in compromised receive RF or
audio intermod or other non-linearities resulting from component saturation, imbalance, or interstage distortion- but have heard no
such issues. I will mention that my recently purchased IC-706 MK II (for mobile use), of more recent design and with some DSP, totally
folds up from same broadcast interference that has no effect on the 940!
The 940 receive audio quality remains exemplary. I have been pleased with the results of the fix, and feel it was worth the effort
to realize the full potential of the original design intent.

I can only think that some amateurs did not have the same results because perhaps the FETs were not closely enough matched to begin
with, or they had other problems, such as bad solder joints as often found in these units?

I hope this information is helpful to you! And yes- it would be nice if Kenwood would enlighten us on these issues- but as the radio is not
a current product, and did quite well even with this 'defect', they have little motivation to do so.

I will look forward to a QSO with you on HF!
73,
John , WA2OOB

Editors Note:
John has undertaken some very useful measurements and it is very useful to have some measurements. Measurement outcomes could be more factual if a change in signal to noise ratio was measured by laboratory methods described by the ARRL. For example MDS.
http://p1k.arrl.org/~ehare/aria/ARIA_MANUAL_TESTING.pdf
http://www.arrl.org/~ehare/testproc/testproc.pdf
If someone could do an MDS noise floor test before and after the FET swap, it would be more complete evidence of the assumed improvement.

Garey Barrell sensibly advises:
Even a good test, i.e., s+n / n measurements before and after, or _accurate_ noise figure measurements really wouldn't impress me that much, since a receiver meeting the Kenwood specs would be limited by external noise regardless!

I suspect Garey is correct about the noise floor: This is a less than 0.2 microvolt receiver: Maybe turning the FETS around produces more noise, [which of course lifts the S meter] but does it produce any more signal or better signal to noise ratio?
If first before an FET swap the S meter was calibrated against a signal generator, then signal strength against independent signal source measured, then an MDS measured, then after the FET swap the s meter was again re-calibrated, then a reading of the independent signal sourceand separately MDS again would show that it was just not an increase in noise.
I wish Kenwood would behave like a responsible manufacturer and explain the technical reasons they do not recommend turning the FETs around.

Have a look at the following links which show how measuring receiver improvement is a difficult undertaking. Even definition of what you are measuring requires some considerable reading and comprehension.

http://www.sherweng.com/table.html

http://www.rac.ca/opsinfo/smeters.htm

http://www.seed-solutions.com/gregordy/Amateur%20Radio/Experimentation/SMeterBlues.htm

http://www.w8ji.com/receivers.htm

RECEIVER 3. THERE IS NO AGC TIMING CORRECTION

STOP: This modification was suggested following Kenwood Japan's advice, that
"The I.F circuit diagram was correct and the I.F. board was labelled incorrectly."
Communications_1_2_with_Kenwood_Japan

Kenwood Japan have now changed their mind and confirmed
"The I.F circuit diagram is incorrect.
Communication 3 with Kenwood Japan

Swapping R149 and R150 probably increases sensitivity to similar degree as achieved by just turning the AGC off

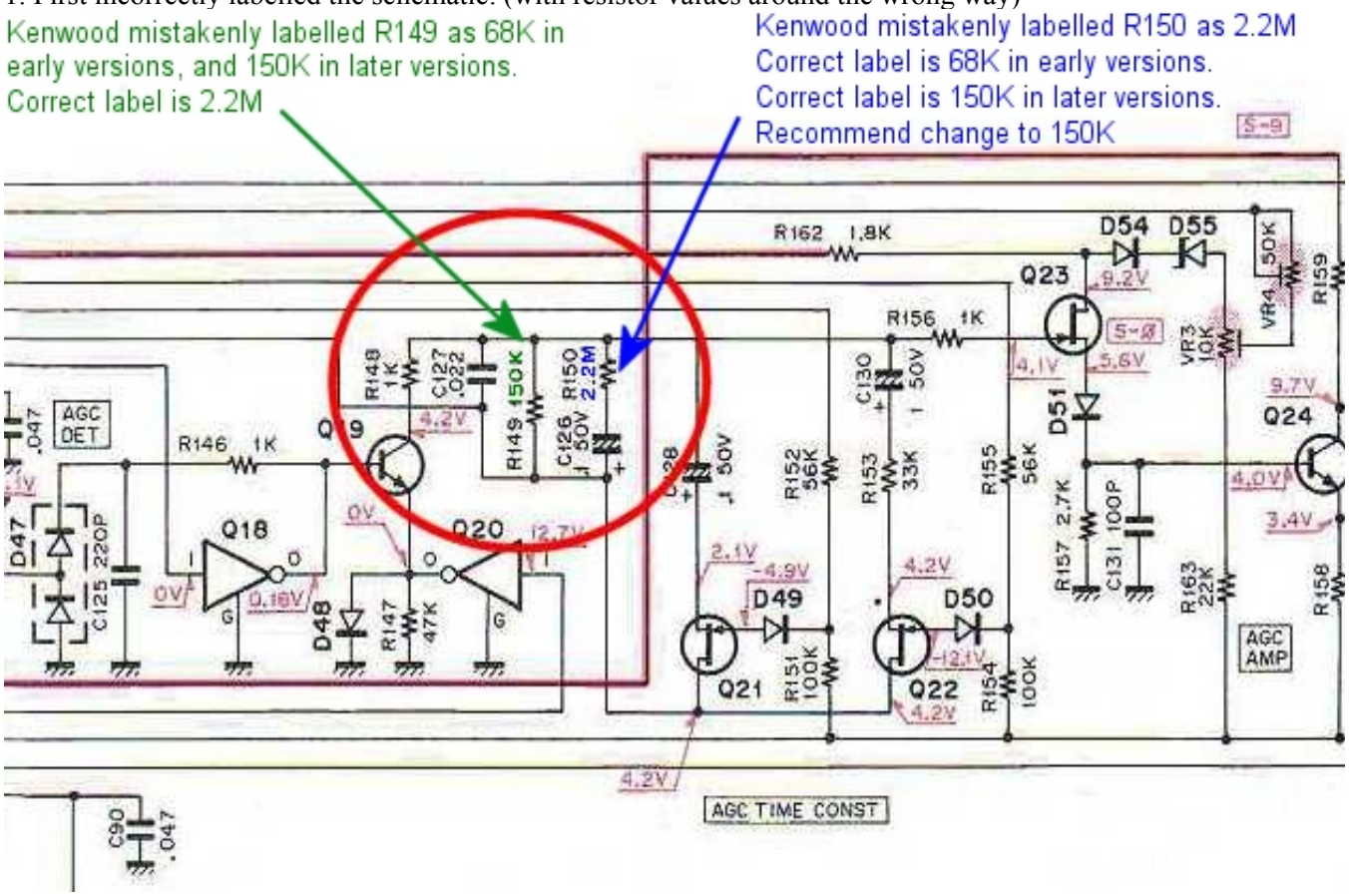
Please review KI4NR's email below advising the (Kenwood intended) correct construction was electrical

layout of the AGC identical to the TS-930.
KINR_email
KI4NR advises the rising S meter caused is leaking in C128 and C130. On the Editors radio C128 has been replaced and does not fix the rising S meter.
When time permits C130 [and / or other AGC capacitors] will be replaced and when replacement has been shown to remove the rising S meter this web page will be updated to confirm that. At that time this section of the web page will be restructured to separate communications about IF circuit diagram from the rising S meter problem.

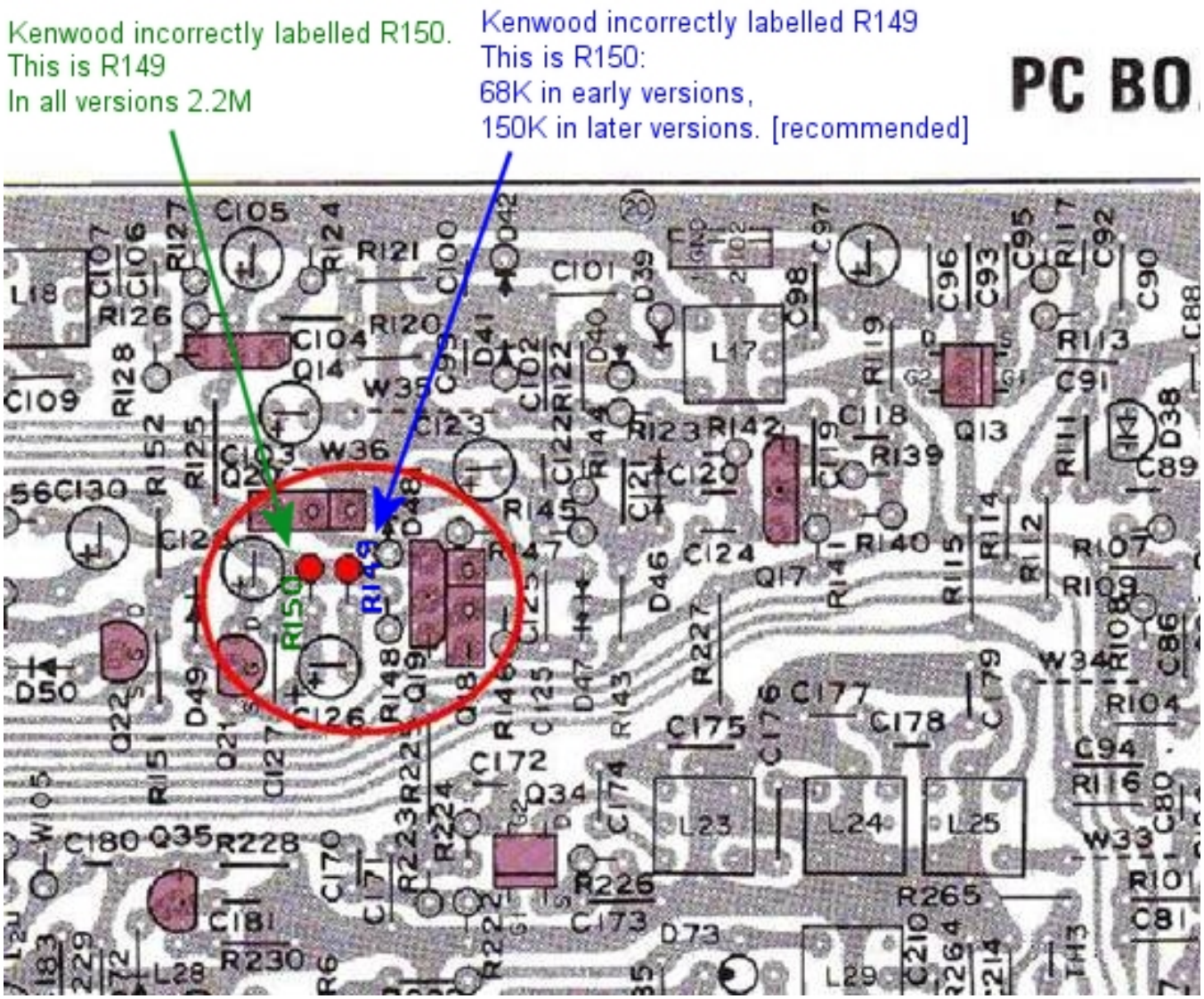
SUMMARY OF R149 AND R150 MIS-LABELLING

Kenwood appears to have done the following: **Please note there are 2 mistakes.**

1. First incorrectly labelled the schematic: (with resistor values around the wrong way)



2. Then incorrectly labelled the PC board [to correct the mistakes on the schematic] so correct resister values put in circuit.
(For example the position of R150 was labelled as R149 on the PC Board, which resulted in a 150K resistor being put at the R150 position.)



Areas in grey below should be disregarded.

Significantly improves the AGC timing function: After modification:

- You hear weak signals a lot better.
- S meter with AGC SLOW ON becomes quite responsive and lively in the region of S1 to S4 signals.
--Before S meter did not move much in S1 to S4 region.
--Before it would take a strong signal to lift the meter suddenly to S4.
I always wondered why the TS-940 behaved differently to other transceivers [TS-930S, TS950SDX] which react much faster over S1 to S4.

Mike KC8ZNW on 25/4/05 describes this same behaviour to the Kenwood.net.

Hello everyone I have a question about the movement of my 940's meter. It seems

that it
barely moves on some signals which are perfectly readable, other sigs give me 8 or 9 and I
have even heard an occasional 10DB+ movement. My TS830S will give me a 2 or 3 s-unit
increase when I switch the antenna to it for the same signal.
Is this an effect of the sensitivity of the receive section? Or do I have a malfunction? In
addition my VFO exhibits the occasional hiccup on the last 2 digits on small movements of
the knob. I understand this may be caused by solder joints.
TIA, Mike KC8ZNW

Executive Summary of AGC Mod

Its easy to modify a TS-940S to hear better (or as well as) a TS-950SDX.
When fixed, TS-940 really pulls out those very weak signals.
Simply swapping 2 resistors around, will enable this rig to hear as Kenwood designed and intended in Kenwood's original circuit diagram.

The error is on the IF board:
Kenwood printed labels for R149 and R150 around the wrong way!!!
As assembled by the factory, (the outcome is) in the main signal path, a 2,200 Kilo-Ohm resistor ends up where a 150 Kilo-Ohm Resistor should be.
Being 14 times larger the 2,200 Kilo-Ohm resistor (incorrectly) significantly degrades the signal.
Swap the resistors around and the receiver hearing improves significantly!!!

Kenwood have confirmed the resistors are in the wrong place. Their emails are below:
Probably "these resistors in the wrong place" occurs in every TS-940S produced.

Independent Feedback on how Receiver Improves

1.
From: Ed [mailto:ca.urso2@verizon.net]
Sent: Monday, 23 May 2005 7:18 a.m.
To: jaking@es.co.nz
Subject: TS-940S

Also, your AGC Timing Correction was applied on my rig (SN 806XXXX) and worked great! Sure enough, resistors R149 (68K on my equip) and R150 2.2Meg had been incorrectly installed by the Mfr. The board markings for those resistors were wrong.

73,
Ed Alves KD6EU
USA

Full email at: FeedbacK_3

2.
From: el34guy@aol.com [mailto:el34guy@aol.com]
Sent: Thursday, 23 June 2005 4:46 p.m.
To: jaking@es.co.nz
Subject: agc modification
Hi Jeff,
I was looking through the 940 page and found my feedback to you(regarding the AGC modification with resistors 149 and 150) under the alc setting portion. Im sure I mislabeled my original email to you on this (think *I wrote alc*). I am having some luck with changing out the 2.2 meg for a 1 meg resistor. Im thinking maybe a little lower value might be worthwhile to test also, like a 6-800k ohm value.
I know I received another email from you on this but I just wanted to let you know it looked like my feedback was in the wrong spot on your page.

-----Original Message-----
From: el34guy@aol.com [mailto:el34guy@aol.com]
Sent: Sunday, 12 June 2005 9:43 p.m.
To: jaking@es.co.nz
Subject: Re: alc mod
Jeff
I thought that mod might be a little better than it was for the alc. It made my radio appear as if it was in fast agc mode all the time. There wasnt a lot of smoothness in the ssb signal that Im used to. Like I said, maybe something like a 1.1 meg is worth considering in there. There isnt much room to solder at all in there. Geez, its tight.
73
Mark

[Editors Note: ZL4AI questions the validity of these observations but has included them to keep feedback information unbiased. Varying the resistors from Kenwoods values was never recommended or intended. With resistors changed around on the Editors 940 AGC slow is still very much slower than AGC fast.]

3.
-----Original Message-----
From: Michael Feryok II [mailto:mikeferyok@yahoo.com]
Sent: Saturday, 9 July 2005 9:57 a.m.
To: jaking@es.co.nz
Subject: AGC Mod

Hey Jeff,
Thanks so much for your TS940 page it helped a co-worker and I today to swap the R149-150 resistors for the AGC mod. Very apparent improvement in noise level and gain. I can hear stations that are buried into the noise floor now. Mike, KC8ZNW

From: ts-940@yahoogroups.com [mailto:ts-940@yahoogroups.com] **On Behalf Of** mikeferyok
Sent: Saturday, 9 July 2005 9:53 a.m.
To: ts-940@yahoogroups.com
Subject: [ts-940] AGC mod works great!!

My friend and I did the R149-R150 swap and it improved the gain and noise level. Adjusted the VR3 for a proper zero on the meter and

worked LZ1YE and YV5YMA right after on 17 meters!
Very low noise compared to before the swap. I highly recommend it.
Thanks to everyone here, and Jeff ZL4AI, Mike KC8ZNW
I'm still debating the transistor gain swap.....????

4.
From: ts-940@yahoogroups.com [mailto:ts-940@yahoogroups.com] **On Behalf Of** Dale
Sent: Tuesday, 12 July 2005 5:37 a.m.
To: ts-940@yahoogroups.com
Subject: [ts-940] Re: AGC mod works great!!

Hello Mike, I'm having both mods done to my 940 now and I hope the out come is like yours. I'll post after I get my 940 back and let everyone know how it goes. I have a very late model serial number which is 20700050 and it still had both mistakes in it, so I hope this will improve on the already great recieve on the 940. 73 and enjoy your improved TS-940S. Dale, KD5UVV

--- In ts-940@yahoogroups.com, "mikeferyok" <mikeferyok@y...> wrote:
> My friend and I did the R149-R150 swap and it improved the gain and
> noise level. Adjusted the VR3 for a proper zero on the meter and
> worked LZ1YE and YV5YMA right after on 17 meters!
> Very low noise compared to before the swap. I highly recommend it.
> Thanks to everyone here, and Jeff ZL4AI, Mike KC8ZNW
> I'm still debating the transistor gain swap.....????

5.
-----Original Message-----
From: Articles@eham.net [mailto:Articles@eham.net]
Sent: Sunday, 24 July 2005 3:52 p.m.
To: jaking@es.co.nz
Subject: [Articles] Improve TS-940 Receiver for Weak Signals

Posted By KB9IV
Well I finally got around to the AGC mod. What a fantastic difference.....it also improves CW to my ears. In addition the AGC mod also seems to improve useable weak sensitivity and decreases distortion.
Forget the "FET reverse" project. NO difference here, it's not worth the risk and time.
Best 73,
Bill KB9IV

-----Original Message-----
From: Bill & Becky [mailto:wmarvin@hickorytech.net]
Sent: Sunday, 24 July 2005 4:00 p.m.
To: jaking@es.co.nz
Subject: 940 AGC Change

Hello Jeff,

Thank you for the info on the "AGC" correction. What a fantastic difference here!!

Makes a good 940 a great 940.....I can now hear much better not. I found the FET reversal change useless.....not worth the bother.

Have a Great Day!!

73
Bill KB9IV .....Minnesota

6.
http://www.eham.net/articles/11090

7.
-----Original Message-----
From: John [mailto:hydroaction@cfl.rr.com]
Sent: Friday, 29 July 2005 4:03 a.m.
To: jaking@es.co.nz
Subject: Your 940 observations

Jeff

I appreciate your efforts on the 940. I have to say the AGC deal is not quite right. I have work on more 940 that I can remember. I have known for years the silk screening of the numbers on the circuit board is wrong. but the resistor placement on the board is correct. also the service manual is wrong on the schematic. The 2.2 Meg ohm resistor is in parallel with C-127 .....the 68K or 150K resistor is in series with C-126 which give you the base line time constant when AGC switch is in the fast postion. This is the CORRECT arrangement. Also if you look at the TS -930 that has the identical AGC circuit this is how it is on that radio too. The reason why you get the AGC rise when the radio has been sitting is the Capacitors are leaky and by swapping the resistors around helps correct that problem. I have had 940's have the rising S meter problem and changing and the caps C128, C130 in the AGC fixed it. This circuit is a Hi impedance type with FET very sensitive and crazy things happen. I have check many, many 940 I have repaired new and old serial numbers and have not found one yet that had the resistors in wrong. Look at the TS-930 schematic to see what I am taking about.

73 John KI4NR

Editors note:
On the TS-930 signal board the equivalent AGC resistors to R150 and R149 are:
R730 2.2M
and
R710 68K

-----Original Message-----
From: LPC Wireless, KI4NR [mailto:lpcwireless@cfl.rr.com]
Sent: Friday, 29 July 2005 5:39 a.m.
To: jaking@es.co.nz
Subject: More Info ... Your 940 observations

Jeff

I forget to add something. When you swap the resistors around. you are putting the 2.2 Meg ohm in series with C-126. this effectively removes the Base line time constant to all AGC positions on the switch including AM even thou the switch does not function there. That why people say the meter is more jumpy. plus the 150 K or 68 K bias the gate of Q23 more heavy and allows the receiver to stay more sensitive to low level signals. if you look at the TS-930 schematic this is the correct circuit in every way and the way Kenwood intended it to work and how the 940 is

One other thing .....on all the older 940 4, 5 and early 6 mil serial number ...the IF board is different. The gain distribution in not the same. All the 940 ... late 6 and newer had better IF boards. They have more gain TX & RX the radio are hotter sensitivity wise, better AGC compression. I use a 5 mil TS 940 with a later model 8 Mil IF board in it .....much , much better !!

Also Kenwood put an S meter slam mod in those boards. all the older 940 when you shut the radio off, pin the S meter over. The newer boards are fix for that.

8.
From: Jeff King [mailto:jaking@es.co.nz]
Sent: Monday, 1 August 2005 8:01 a.m.
To: 'css@kenwood.co.jp'
Cc: 'lpcwireless@cfl.rr.com'
Subject: RE RE: Is your advice Correct about TS-940 R149 and R 150: being in wrong places???

Dear Mr T.Soranaka

Thank you so much for your 2 emails sent in March 2005 [attached as below].
COMMUNICATIONS_WITH_KENWOOD_JAPAN About R149 & R150
From your advice I understood:

“The I.F circuit diagram is correct about positions of R150 and R 149 and the I.F. board is labelled incorrectly.”

Because your advice was valuable I recorded this to a small web page:
http://homepages.ihug.co.nz/~jaking/TS-940_02.htm
This has been seen by some TS-940 enthusiasts. It enables one to adjust a TS-940 to operate as (you advised) Kenwood designers really intended.

A very experienced Kenwood repair expert from the USA very strongly suggests your advice may not be correct. The reasons he states sound correct and are very convincing: Those reasons are summarised below.

With the greatest of respect to Kenwood Corporation and yourself I ask please:
Could you please review your advice and advise again if R150 and R149 on the IF Board should be swapped around to make the TS-940 to operate as Kenwood designers really intended?

==========
30 July 2005:
Abbreviated summary of key points in Emails from KI4NR Kenwood Repair Expert in USA

When R149 and R150 are swapped around the AGC does not function as Kenwood intended.

- The service manual is wrong on the schematic.
- The silk screening of numbers on the circuit board are reversed to the schematic and wrong in relation to the

schematic (only).
- But the resulting resistor placement on the board is correct.

I believe the silk screening on the 940 IF board is correct and the IF schematic is wrong.

The 2.2 Meg ohm resistor is in parallel with C-127 .....the 68K or 150K resistor is in series with C-126 which gives the base line time constant when AGC switch is in the fast position. This is the CORRECT arrangement.

The 2.2 meg ohm resistors in both the TS-930 and TS-940 sets up the bias to the FET from the 3.2 volt AGC reference voltage. The 68k or 150k in series with the Cap set up the base time constant. The other FET switch in for slow AGC on SSB and Fixed AGC on AM.

Also if you look at the TS-930 (both schematic and signal board) that has the almost identical AGC circuit. (R730 2.2M and R710 68K, are the equivalent resistors on the TS-930.) The TS-930 is the correct circuit in every way and the way Kenwood intended "the AGC of the TS-940" to work.

When you swap R149 and R150 around. you are putting the 2.2 Meg ohm in series with C-126.
This effectively removes the Base line time constant to all AGC positions on the switch including AM even thou the switch does not function there. That is why people say the meter is more jumpy. Plus the 150K or 68K bias the gate of Q23 more heavy and allows the receiver to stay more sensitive to low level signals.

73 John KI4NR

LPC Wireless
lpcwireless@cfl.rr.com
Phone: 386-774-9921

==========

Mr T.Soranaka I look forward to receiving your advice.

Yours sincerely
Jeff King

9.

```
-----Original Message-----
From: Customer Service Section [mailto:css@kenwood.co.jp]
Sent: Tuesday, 2 August 2005 6:01 p.m.
To: jaking@es.co.nz
Subject: Re: RE RE: Is your advice Correct about TS-940 R149 and R 150: being in
wrong places???


Dear Mr.King,

Please accept my apologies for having supplied incorrect information.
A very experienced Kenwood repair expert from the USA is right.
The service manual is wrong on the schematic.

Yours sincerely,

T.Soranaka
++++++++++++++++++++++++++
Customer Support Center
```

Kenwood Corporation
(Japan)
URL: http://www.kenwood.com/
Email: css@kenwood.co.jp
++++++++++++++++++++++++++

10.
From: John Brush [mailto:brushj@comcast.net]
Sent: Monday, 12 September 2005 2:29 p.m.
To: jaking@es.co.nz
Subject: TS-940S R149/R150 More Info

Jeff,

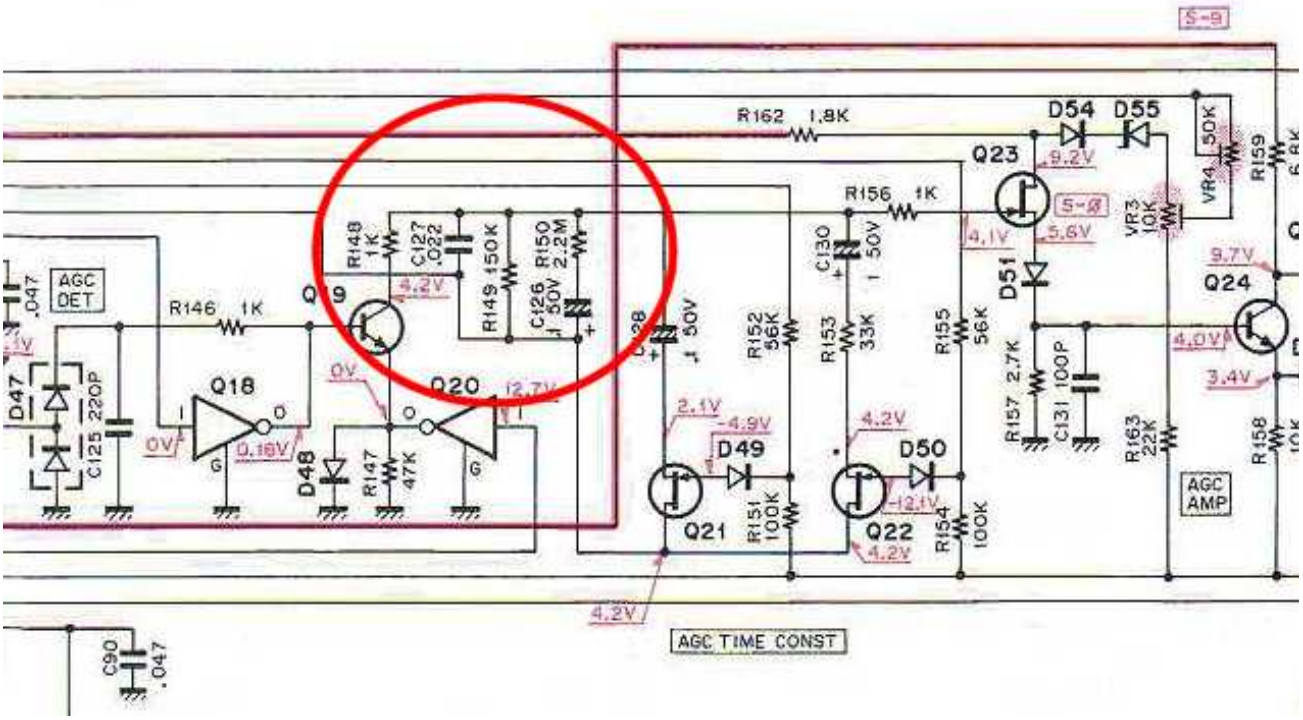
I absolutely agree with the comments made by John KI4NR. A rising S-meter reading is due to a leaking capacitor, and not the incorrect placement of R149/R150. In my case, I did the resistor swap and noticed that the S-meter's response was the same for both the AGC's Fast and Slow positions – not good. After undoing the resistor swap, I now had the rising S-meter problem (a problem I didn't have before the modification). In my case, the problem was resolved by replacing C126, the capacitor that is in series with R150 (2.2M) as shown on the schematic. Per John's advice, I also plan on replacing C128 and C130.

I must have one of those old IF boards, because my S-meter pegs when I turn the radio off.

73, John (WA3CAS)

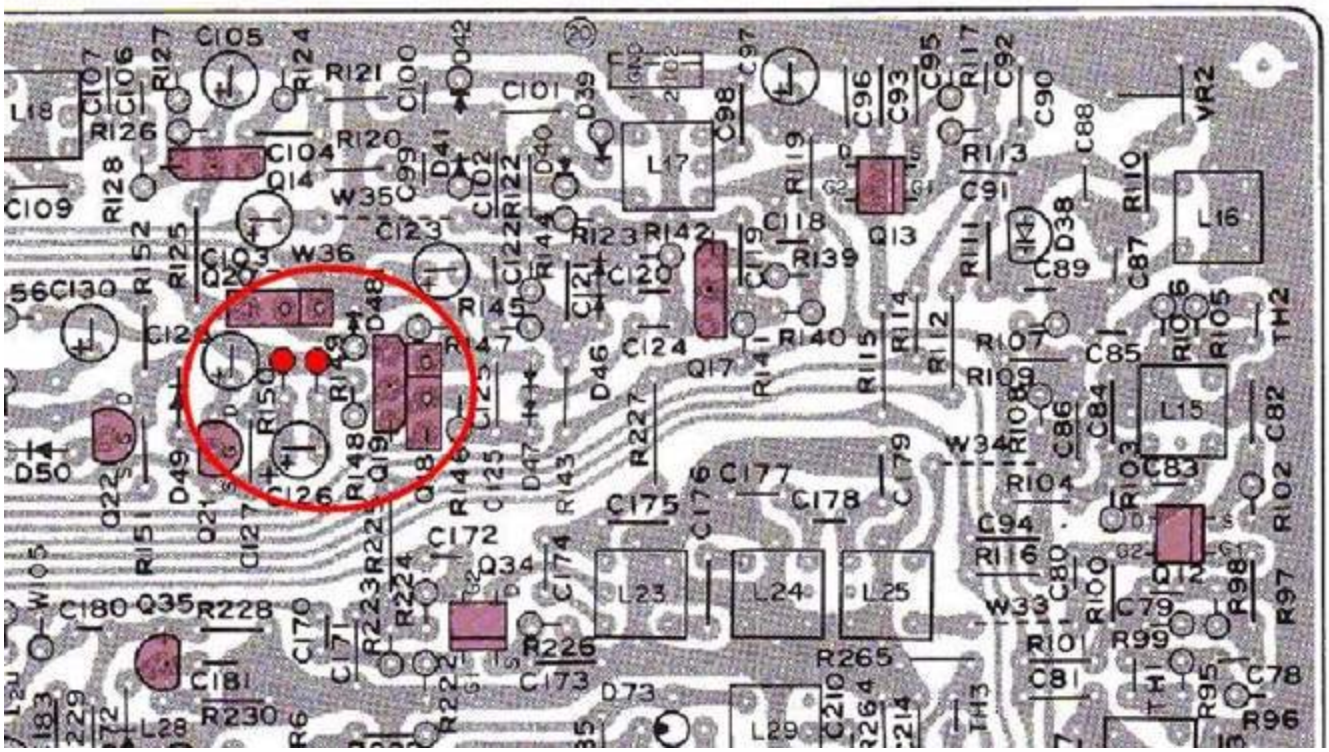
THE PRODUCTION MISTAKE DESCRIBED:

Below is Page 92 of the Revised Service Manual
Observe that:
- **R 149 and R 150 are mounted between almost the same connections. I.e. between the junction of C127- R148 - C128 - C130 - R156 to-> C126 - Q21 - Q22**
- **The difference being that "additional C 126" is between R150 and C126 - Q21 - Q22**



Below is page 93 of the Revised Service Manual
You will notice that R 149 is connected between C126 and the junction of C126 - Q21 - Q22. That is R149 has been mounted where R 150 should be.

PC BOARD VIE



Does putting the 2.2M ohm resistor where the 150 ohm Resistor should be make a difference. **Yes! You bet.** Change the 150 ohm back to the direct circuit and the AGC responds very quickly. [similar to the AGC in a TS-930]. AGC could not respond quickly before because it had to wait until C126 charged up.
This is in the heart of the AGC timing section.
Probably all TS-940s have R149 and R150 in the wrong place.
==========

TO CHANGE THE RESISTORS

Change around is easy.
You will need to take the IF Board out.

The difficult part is removing and putting all the connectors off / on the board. Before starting, draw a diagram of the board showing each connector and position and colour of its wires.
That makes it certain you put the right connectors back in the right places.
If you don't draw a diagram you will not know where all the connectors go back.
Some two pin connectors could easily go in more than one place. That's could be disastrous
These colours are not shown in the service manual.

I suggest you put in new resistors, because with longer leads they will slightly easy to hold in place while soldering.

THE INITIAL PROBLEM SYMPTOMS:

ZL4AI discovered this while searching for the a fault described below
AGC:
Only happens in SSB:
If TS-940 left not running for a couple of days, when you turn it on, with the AGC turned off or set in fast position, then the meter needle goes to up 25db + 9 (approx). The signal is diminished like RF gain turned up. Over the next 25 minutes the meter needle slowly moves it way back to S0.
SSB in normal position, and TS-940 turned on this does not happen.
Needle is initially at s0.
During the first 25 minutes if you switch between off - fast - normal then the needle goes back to zero in less time ... say 20 minutes.
If TS-940 left for a couple of months, and then turned on same behaviour but worse.
Meter needle goes full scale right in all positions (off - fast - normal)
It takes longer say 40 minutes for the needle to move to the s0. then ts-940 functions as described above.
==========

After R149 and R150 changed back to positions Kenwood intended in the circuit diagram, the result was:
-The fault of the rising S meter when cold disappeared.
- S meter dropped back to S1 on both AGC OFF and AGC SLOW, with no antenna signal. Needed to adjust VR3 to bring the S Meter to S0.

ACKNOWLEDGEMENTS TO PERSONS WHO HELPED SOLVE THIS

T.Soranaka Kenwood Japan was most helpful. You will see in the emails below Kenwood have readily confirmed that these components are around the wrong way. Then in a third communication (above) confirmed they are correctly installed.

Traian Belinas
traian@deck.ro
who diagnosed the problem and really understands these circuits. Traian appears to have amazing skill and after reading the symptoms pointed me to look at R149. From there it became obvious the circuit was not assembled according to the circuit diagram.

Garey Barrell
'k4oah@mindspring.com'
Who provide some very useful advice on functions of components and explanations how to read the circuit diagrams.
==========

A CAUTION:

Not all IF boards are identical.
I installed another IF board installed as per factory spec with R149 and R 150 in their other components position in my TS-940. It did not have the rising S meter problem. But it was not sensitive to weak signals
==========

COMMUNICATIONS WITH KENWOOD JAPAN BELOW:

-----Original Message-----
From: Customer Service Section [mailto:css@kenwood.co.jp]
Sent: Tuesday, 15 March 20057:11 p.m.
To: jaking@es.co.nz
Subject: Re: Question about TS-940 R149 and R 150: Appear to be in wrong places!
Dear Customer,
Thank you for your reply. I suppose that currently R149 and R150 are mounted correctly as the screen printing lettering R149 and R150 are reversed. Please confirm actual resistors comparing the circuit diagram. The circuit diagram is correct.
Yours sincerely,
T.Soranaka
++++++++++++++++++++++++++
CustomerSupportCenter
Kenwood Corporation
(Japan)
URL: http://www.kenwood.com/
Email: css@kenwood.co.jp
++++++++++++++++++++++++++

----- Original Message -----
From: Jeff King
To: 'Customer Service Section'
Cc: k4oah@mindspring.com ; traian@deck.ro ; Bill Bailey ; Ken McVie
Sent: Tuesday, March 15, 20051:53 PM
Subject: RE: Question about TS-940 R149 and R 150: Appear to be in wrong places!
Dear T.Soranaka
Thank you for your advice.
Could you please advise if it would be advisable to swap R149 with R 150 and vice versa, so the TS-940 functions in accordance with the circuit diagram?
Yours sincerely
Jeff King
-----Original Message-----
From: Customer Service Section [mailto:css@kenwood.co.jp]
Sent: Monday, 14 March 200510:29 p.m.
To: jaking@es.co.nz
Cc: kcc-amateur@kenwoodusa.com; sabura.tech@kenwood.com.au
Subject: Re: Question about TS-940 R149 and R 150: Appear to be in wrong places!
Dear Customer,
We are sorry for inconvnience. I have checked with our communication department as to R149 and R150. Unfortunately reference number of R149 and R150 on the borad are reversed. R150 and R149 are 2.2M and 68K or 150K respectively as shown in the Service Manual.
Yours sincerely,
T.Soranaka
++++++++++++++++++++++++++
CustomerSupportCenter
Kenwood Corporation
(Japan)
URL: http://www.kenwood.com/
Email: css@kenwood.co.jp
++++++++++++++++++++++++++

----- Original Message -----
From: Jeff King
To: css@kenwood.co.jp ; kcc-amateur@kenwoodusa.com ; sabura.tech@kenwood.com.au
Cc: k4oah@mindspring.com ; traian@deck.ro ; Bill Bailey ; Ken McVie
Sent: Saturday, March 12, 20056:41 AM
Subject: Question about TS-940 R149 and R 150: Appear to be in wrong places!
Dear Kenwood Customers Services,
I have found that when emailing Kenwood USA about a Kenwood USA product I got redirected to contact a Kenwood representative close to my home location. I am not sure who is best to send this to. So I am sending it onto to all Kenwood contacts.
Thank you for your recent replies.
While trying to find a fault in my TS-940 I have been going over the IF board. It appears to me when the board was made it was marked with the screen printing lettering of R149 being where R150 should be and vice versa. I have followed the board traces both in the Service Manual and on the back of a board, and these resistors both seem to be in the wrong place.
This means:
Specified in First Service Manual:

R149 68K
R150 2.2M
Specified in Revised Service Manual:
R149 150K
R150K 2.2M
Resistors as actually installed on my board if you follow the logic of the circuit diagram.
R149 2.2M
R150 150K
I have two IF boards here and they both have the resistors installed as required by the screen printing and hence on both boards both resistors are reversed. Possibly this is the case for every TS-940 ever made.
I cannot understand how the circuits would function as the designer intended, as the installed resistors are very different to those shown on the schematic diagrams. Could you please advise if my observation is correct, and after later when Kenwood has investigated if it would be advisable to swap R149 with R 150 and vice versa?
At this time could you please just confirm that the question will be investigated?
I look forward to your reply.
Yours sincerely
Jeff King ZL4AI

RECEIVER 4. PIN DIODE IMPROVEMENTS

This improvement is not fully documented yet. Please send in information.

4.1: Background on how Pin Diodes were discovered to improve radios.

[TenTec] Pin Diodes / Paragon
Chester Alderman chestert@pressroom.com
Wed, 17 Sep 1997 17:14:45 -0400

TenTec builds a great amateur radio and obviously to give you a 'million dollar radio' that cost the user five bucks, picture. PIN diodes have been around for many years, however they were initially invented, designed, manufactur devices, obviously because you can not use mechanical relays for internal switching within a microwave RF circui frequency' device until within the last 20 years or so.

Dont quote me on this because I've been out of microwave design for too long. A regular diode is a piece of silicor side of the junction is doped, during mfg process, to have an excess of electrons (+P) and the other side of the diod therefore the term PN junction. And of course a PN junction diode will pass current (a signal) in only one directior characteristics (but each side is doped differently than than a standard diode), and in addition, between the +P and doped specifically to allow the diode to switch VERY rapidly, and this region is called the Intrensic junction, thus

can switch is basically determined by the width of this Intrensic area, the narrower the I junction, the faster it will s
frequency that you can pass throught it. Unfortunately, to build a PIN diode that will switch at HF freqs (below 30
or the diode will switch too fast to allow one cycle of an HF signal to pass through it.

What all of this means is that PIN diodes are relatively expensive. A regular PN junction diode (typically a 1N414
however a 'cheap' true PIN diode will cost between one and three dollars apiece; and thats why you do not see ther
ECONOMICS. (I'm not sure why it took that much verbage to explain, but it did.)

Corsair II's used a regular silicon switching diode, 1N4148 to switch the filters. The Omni 6 does use PIN diodes, l
mentioned economics, TenTec uses diodes that 'will do the job' verses expensive PIN diodes.

I read Rhode's article on PIN diodes and decided I could improve the IM performance of my Omni 6 (it didn't neec
Packard PIN diodes that Rhode stated were the best, and installed them in my Omni 6. Over the past five years usi
in some serious DX contest, I have yet failed to see where these expensive HP PIN diodes made any substantial im

TenTec runs about 10ma of current through their production PIN diodes, in order to gain the full IM advantage of
through the HP PIN diodes!

So the bottom line is if you replace the PIN or silicon diodes in a rig, you will see (hear) practically no improveme
utilize the diodes operating at their optimum design specifications. Probably if you find the filter switching diodes
probably means that someone has taken the time to change the current running through the switching diodes to rea

At 01:32 PM 9/17/97 -0400, you wrote:

>H. M. 'Puck' Motley W4PM wrote:
>> I have the feeling that the pin diodes in question are a modification
>> suggested in an article by Ulrich Rhode (not sure of the spelling of his
>> name) a few years back concerning 2nd order IMD in modern rigs. One of
>> the rigs mentioned was the Paragon. The article stated that by replacing
>> the common switching diodes used to switch the receiver front end band
>> pass filters with a certain type of pin diode, 2nd order IMD could be
>> improved. Maybe some of our more technically oriented folks remember this
>> article and can comment in greater detail. This is all I remember so if
>> you have additional questions don't ask me!
>Thanks, Puck. I was certain it was something Rohde said, just wasn't
>quite sure when or what the exact reason was. I just spoke to Ten Tec
>about this, and they actually said they had tested different types of
>diodes to switch the Paragon's receiver filters, and settled on regular
>switching diodes because there wasn't much difference with other types.
>So, I guess replacing the receiver filter switching diodes with PIN or
>other (hot carrier, etc.) types is probably a mod that some users have
>done themselves. At least I know for sure it's not a factory
>modification.

>Is there anyone out there who knows this for sure? Has anyone done the
>aforementioned mod? I know one fellow recently mentioned in a message
>that a rig he had for sale had the mod. Now I'll go search for the Rohde
>article. 8^)

>73, KE3KR

4.2 RadCom Technical Topics explains what Pin Diodes were supposed to achieve.

TECHNICAL TOPICS April 1995
RF SWITCHING I TUNING DIODES

TT FEBRUARY 1993 REPORTED briefly an important article by Dr Ulrich Noble, KA2WEU/DJ2LR, which was published simultaneously in English and German QST and *CQ-DL* November 1992) on "Recent advances in shortwave receiver design". He subsequently published a series of three articles (QST May, June and July 1994)on Key components of modem receiver design, and a recent follow-up Key components of modern receiver design: a second look" (QST, December 1994). In these articles he stressed that for receivers intended to have a very wide dynamic range, the intermodulation distortion that arises from the use of unsuitable RF switching and tuning diodes imposes an important limitation. He has recommended the use (or substitution) of such special-purpose RF diodes as the Hewlett-Packard HP5082-3081 PIN diodes.

Dr Rohde's articles encouraged Tom Thomson, WOIVJ, to investigate how bad in practice are the more distortion-prone switching diodes and how good are those designed for low distortion ('Exploring intermodulation distortion in RF switching and tuning diodes', QST, December 1994). He carried out laboratory tests on four types of diodes: The IN4153 generic PN switching diode: the Motorola MPN 3700 PIN diode intended for RF switching; the BAT-17 Siemens PIN switching diode; and the low-cost 1N4007 which is a generic 1 kV-PIV rectifier diode with a PIN structure but not intended for RF switching

He has tabulated results in terms of diode switch insertion loss (dB) at 1O MHz with 0, 5, 10 and 20mA bias currents; and similarly the second- and third-order intercept points (IP2, 1P3 and dBm). He draws the following conclusions: "RF-specified PIN diodes are the devices of choice for low-distortion switching at HF and above, for band pass filter selection and C switching in a narrow-band pre-selector. Although the presence of a PIN structure in the 1 N4007 makes it seem attractive as a low-cost alternative to RF-specified PIN diodes, its insertion-loss performance When unbiased and reverse-biased - and its IMD performance when unbiased - is demonstratively interior to RF-specified PIN diodes.

He adds: 'The manually switched and tuned front-end filters of the 1960s and 1970s had much to offer in terms of second-order IMD, but we need not retrogress to those techniques to achieve improved 1P2 and 1P3 performance today. More attention paid to front-end filtering in general can produce the improvement we need."

Dr Rohde in commenting on W0IVJ's finding, notes that many amateurs had reported difficulty in obtaining HP5062-3081 diodes. He recognises that even with the Motorola MPN3700 with a US price Of less than £11 replacing all 20-plus filter-switching diodes can be expensive. Nevertheless he recommends changing all the diodes between the antenna and the first mixer, which includes the diodes on both sides of the band pass filters of a transceiver but not the transmit/ receive switching diodes which typically are already high-quality PIN types. He also adds some notes on Japanese switching diodes which might be used to replace the 'bad' diodes seen in the past".

Pat Hawker's Technical Topics

PAT HAWKER, G3VA
London 37/SE22 8SS

RF SWITCHING DIODES CONTROVERSY

AN APRIL *TT* item ('RF Switching and Tuning Diodes', p63) drew attention to the series of QST articles by Dr Ulrich Rohde, KA2WEU/ DJ2LR - recognised world-wide as a leading professional expert in HF receiver design - supplemented in a separate *QST* article by measurements made by Tom Thomson, WOIWJ. These highlighted the shortcomings of some general purpose PN and PIN diodes used for RF switching in some popular amateur HF transceivers. Dr Rohde pointed out that the second order IMD performance could be improved in such cases by substitution of PIN diodes specifically designed for RF purposes, and in particular recommended the Hewlett Packard HP5082-3081.

In part three of his article (*QST*, July 1994) Dr Rohde gave results of measurements made on unmodified and modified transceivers - an ICOM IC-765, a Yaesu FT890 and a Kenwood TS-50. These measurements suggested significant improvements in second and third order IMD performance. He also evaluated the second-order IMD performance of several other transceivers including Collins KWM-390, TS950SDX, Ten-Tec OMNI VI (second order intercept +43dBm) and FT-1000. But he did not appear to specify which, if any, of this second group would or would not benefit from diode replacement. As a result of his findings, ARRL decided that they would include second-order IMD measurements in future *QST* Equipment Reviews.

This is highlighted in a letter from Dave Farn, G4HRY, who reported the unfortunate experience of G4KPT who replaced all 40 switching diodes in his Omni VI only to find that sensitivity had suffered. As a result, G4HRY has now replaced the original diodes and believes that "the validity of the original articles is brought into doubt". G4HRY, however, was not able to check on second-order IMD performance before or aftermodification.

While I am sure that Dr Rohde could provide a convincing reply to his criticisms, G4HRY does make some comments that deserve to be aired. He writes:

"G4KPT read the *QST* articles and as the OMNI VI was specifically mentioned, decided to replace all of the switching diodes in the transceiver front end with HP5082-3081 types.

Freq	BA482	HP3081	BAT85	1N4148	BA439	IN4007
1.8MHz	-0.6	-0.9				
3.5MHz	-0.4	-0.75				
7MHz	-0.2	-0.7	-0.6	-0.7	-0.55	-0.5
10MHz	-0.3	-0.8				
14MHz	-0.2	-0.9				
18MHz	-0.3	-0.8				
21MHz	-0.3	-0.9				
24.5MHz	-0.3	-0.9				
28MHz	-0.3	-0.98	-0.6	-0.7	-0.55	-0.5

Table 1: G4HRY's measurements of diode loss (dB) in 50Ω transmission path with 10mA forward bias.

"After completing the modification he noticed that the receiver seemed a little deaf and the S-meter could no longer be calibrated. Thinking he had introduced a fault, he brought the set to me for a second opinion. Tests showed the sensitivity was at least 5dB worse than another OMNI VI. I could not find a hard fault with the rig and decided that, as it had worked well before modification, it was probably something to do with the new diodes. To prove this I built the small jig shown in **Fig 1**. This enabled diode through-loss to be measured in a 50Ω system which can be equated to diode RF resistance. The jig was used to measure the BA482 types and then the HP PIN diodes. Out of interest, I took a quick look at a variety of other general purpose diodes and this indicated that in respect of through-loss, the original diodes selected by Ten-Tec were a good choice: see **Table 1**.

"The receive RF path of the OMNI VI includes 5 diodes before the 1st RF amplifier. The first two isolate the transmitter from the receiver input, the next two select the appropriate bandpass filter. The final diode in the chain feeds the input of the RF amplifier in the

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MPN3700	

simple addition and subtraction of input-signal frequencies. His introductory notes on switching diodes were as follows:

"The receiver sections of amateur MF/HF transceivers generally use diode-switched front-end filtering. The switching diodes used have low junction capacitance and can typically handle medium DC levels (10 to 100mA). These characteristics are important because we want these diodes to contribute minimal loss when turned on and leak very little RF when turned off.

"The two-tone, third-order MD dynamic-range testing routinely done to amateur transceivers seems to point up no weakness in these switching diodes. In real life, however, a huge number of signals simultaneously appear at a transceiver's antenna connector. Periodically, their voltages all sum in phase producing, for short durations, enough voltage to change the bias of the diode at the input of the filter in use. This causes intermodulation distortion - generally ,second-order IMD. This is ironic for two reasons: First, this diode-generated IMD generates exactly the interference the filters switched by the diodes are supposed to prevent! Second, amateur radio equipment reviews have long let second-order front-end IMD go unmeasured because we have long assumed that our radios front-end filtering reduces this IMD to a non problem. Later, I will present measurement results that prove that second-order IMD is a very real problem today. (The test jig used by WOIVJ is shown in **Fig 2** with some of the results in **Table 2** - *G3VA*).

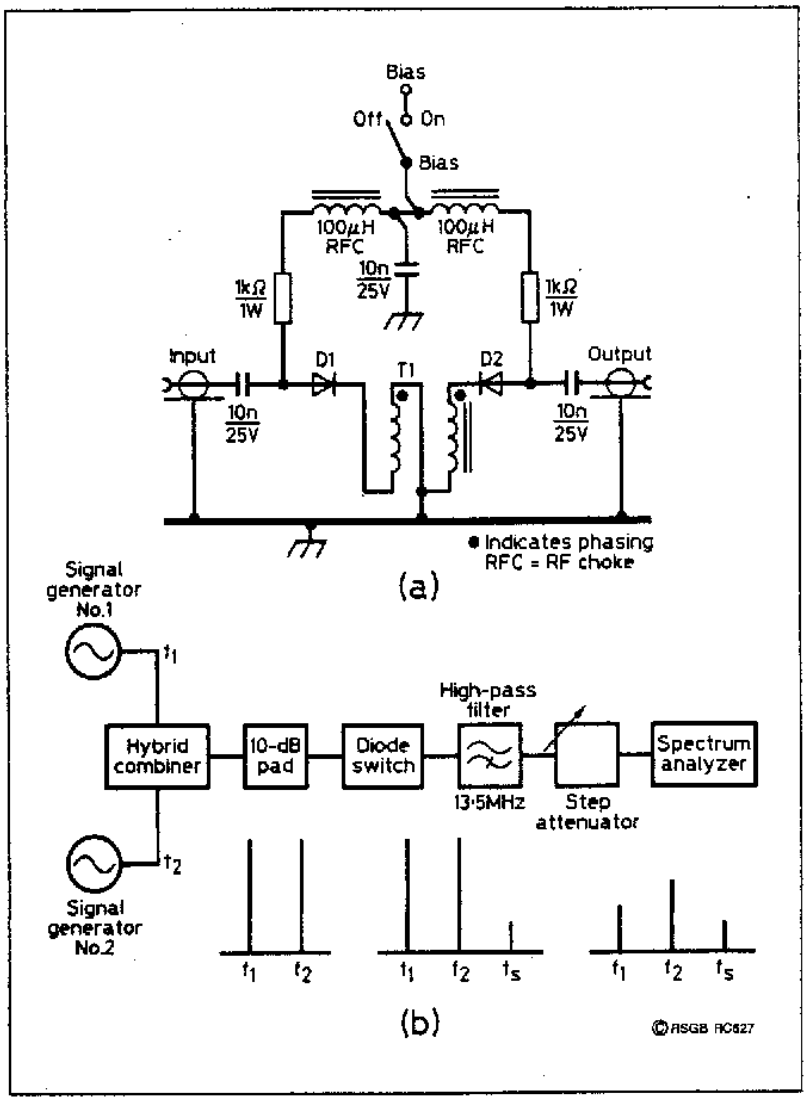

Fig 2: (a) The diode switch used by WOIVJ for his tests. D1 and D2, the diodes under test, included PN and PIN (power-rectifier and RF-specified) types. Capacitors are disc or monolithic ceramics. T1 consists of 11 bifilliar turns of Nr28 enamelled wire on an FT-37-43 ferrite toroidal form; the inductance of each winding is about 50uH. (b) Set up for measuring the diode switch's second - and third-order intercept points.

"The best way to avoid switching-diode IMD is to switch the filters with relays instead of diodes, and military and commercial gear generally take this approach. Relays are costly, however. A less expensive workaround that is acceptably good for amateur radio equipment is to use diodes - PIN diodes - designed for this application. The two best-

if anyone can suggest modest-priced diodes that are better than the 1N4148 and will stand up in service? Meanwhile, I am unable to detect any difference between a new FT757 and one that has had 1N4148s fitted".

My own feeling is that the experiences of both G4HRY and G3LLL highlight an increasingly serious problem involving modern technology. Without the most advanced (and ex-

DIODE TYPE	FREQUENCY 1.815MHz (dBm)	(dB)	FRE 7.((dBm
BYD11M (@6 & 10mA)	38.0	1.16	45.(
IN4007 (@6 & 10mA)	38.0	0.25	42.(
HP3081 (@6mA)	38.0	3.82	37.(
HP3081 (@10mA)	35.5	2.68	41.(
BA482 (@14mA)	25.0	0.51	38.(
BA482 (@6mA)	18.5	3.49	23.5
IN4148 (@6mA)	21.2	6.61	19.(
IN4148 (@10mA)	12.5	3.61	15.(

Table 1: Third order intercept (dBm) and Test circuit insertion loss

DIODE TYPE	FREQUENCY 1.815MHz
BYD11m	73.9
1N4007	63.0
HP3081 @6mA	80.0
HP3081 @10mA	81.9
BA482 @14mA	80.0
BA482 @6mA	84.0

Table 2. Test circuit off isolation (dB).

ANOTHER LOOK AT RF SWITCHING DIODES

DAVE FAR, G4HRY, in 'RF Switching Diodes Controversy' (*TT*, July 1995, pp67-78) questioned the wisdom of wholesale substitution of HP 5082-3081 RF PIN diodes for the switching diodes fitted in the front-ends of typical modern HF transceivers. This item interested a number of readers concerned with the development of high-performance receivers including Colin Horrabin, G3SBI. He felt that the performance data provided by G4HRY and earlier by Tom Thomson, W0IVJ, in *QST*, December 1994 (summarised in *TT*,

that an important factor with some diodes is the sensitivity of insertion loss to forward current. The HP 3081 diode, severely criticised by G4HYR, shows a marked reduction of loss and hence improved performance as the forward current is increased from 6 to 10mA. As noted by G4HRY the Siemens BA482 (as used in the Ten Tec Omni) shows the lowest insertion loss (this would seem also to confirm G4HRY's view that it is inadvisable to replace BA482 diodes with HP3081 diodes - *G3VA*).

"Clearly anyone contemplating changing the RF switching diodes used in his transceiver must first estimate or measure the 'on' current used in the particular model concerned.

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TECHNICAL TOPICS

"The 1N4007 performance encouraged us to obtain some BYD11M diodes from RS Components (29p each). These are rated as 1000V PIV, 0.5A rectifier diodes and are the same physical size as normal signal diodes. Performance as switching diodes was good: relatively low insertion loss, good IP3 intercept point, and good degree of 'off-isolation' at 50MHz, even with a fairly low 'on' current: see **Fig 4 (a)** and **(b)**.

"It should be appreciated that a very high degree of 'off-isolation' between different bandpass filters is less important in up-conversion receivers (50dB is probably adequate) since the image frequency will be in the VHF region and will be largely taken out by low-pass filters before the mixer. However, in the case of a receiver with a 9MHz IF and a 5MHz local oscillator, the image will fall in the 3.5 and 14MHz bands. In this case, isolation between the filters should be greater than 90dB so that two diode switches in series with a shunt diode would be needed to achieve this degree of isolation. It would be better to use double-pole relays, one bandpass filter to ground. It may then be necessary to use the technique of 'DC-wetting' ie arranging to pass a few mA of direct current through the relay contacts, to improve long-term contact reliability."

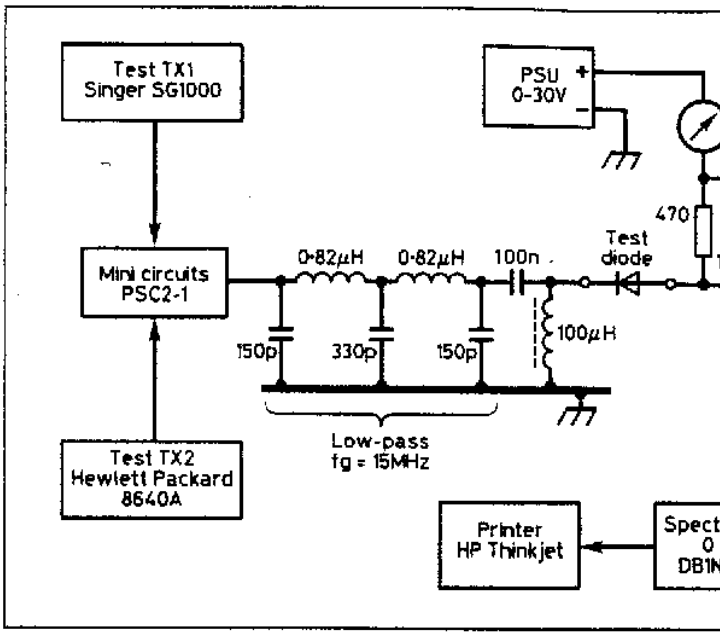

Fig 5: Test rig used by DB1NV for the measurement of intermodulati

B J Mitchell, G3HJK, commenting on the strictures by G3LLL on the long-term reliability problems of RF switching by relays (*TT*, September, p68) also draws attention to the better reliability that can be achieved by DC-wetting, a long-established Post Office dodge, both in minimising oxidation and in reducing migration of contact material. This can be

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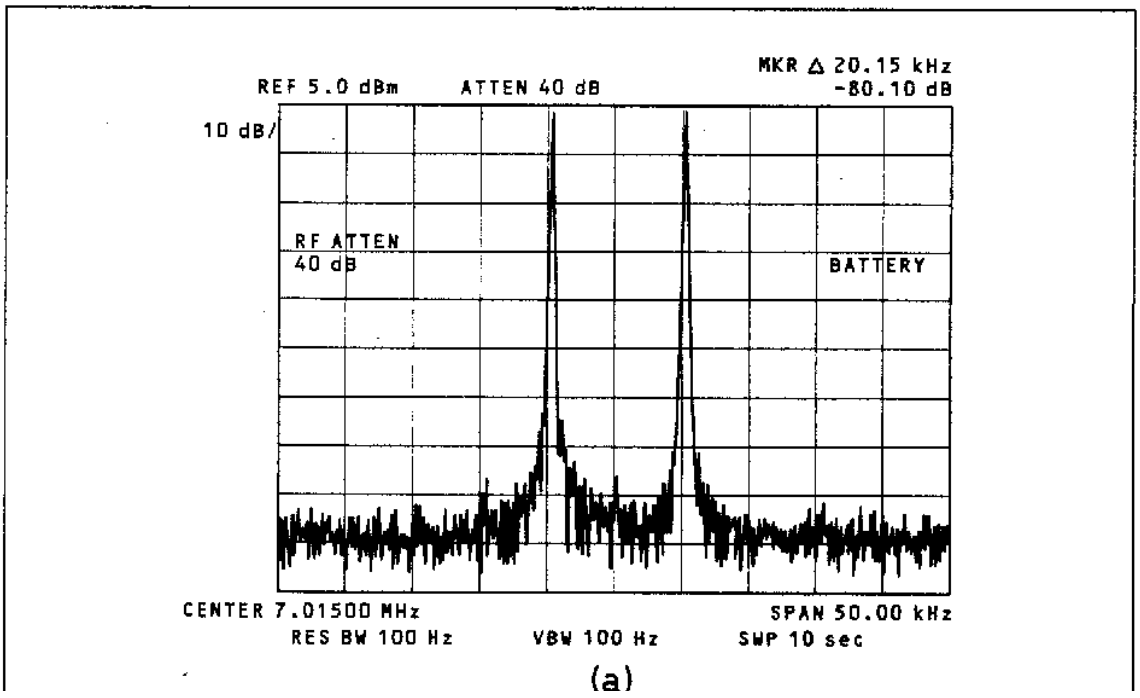


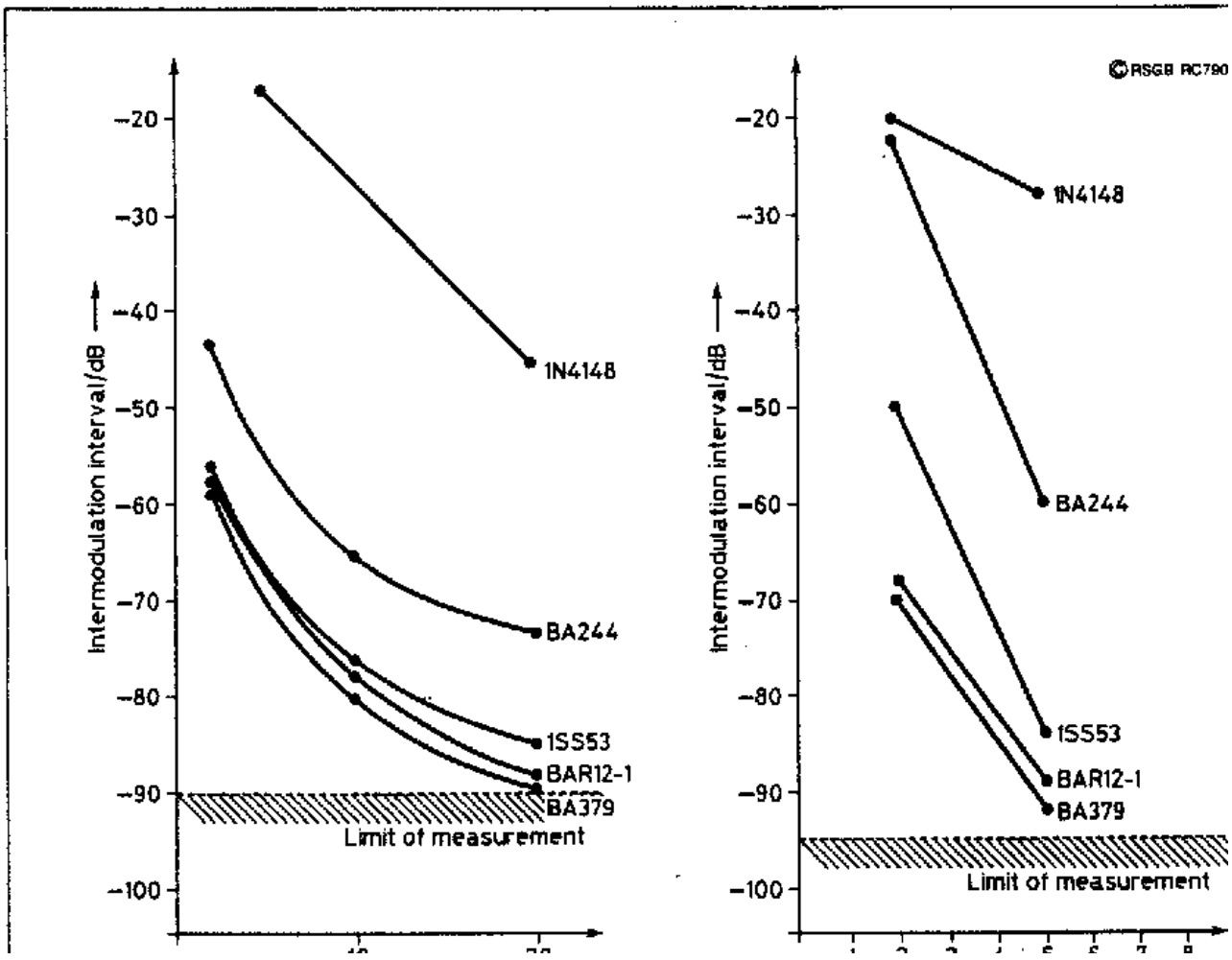
DB1NV also investigated the IM products resulting from saturated ferromagnetic cores, as used in both the aperiodic case (RF chokes) and for tuned (resonant) circuits. He found, for example, that Amidon ring cores of various sizes and intended for HF applications were practically free from intermodulation effects under normal conditions. He did, however, provide some design tips "some of which are not new, but which have probably fallen into oblivion in Japan". He wrote:

(1) Input filters effectively resistant to IM can be produced only using sufficiently large iron powder ring cores as inductances. They offer the best compromise between the space requirement and the level controllability.

(2) In compact rigs, rod core chokes, su the Siemens MCC, can be considere alternatives.

(3) Chokes in the filter structure, eg o operating voltage feed, are largely critical provided they do not resonat

DB1NV recalled the band-pass filter ing ring core coils that were publicised r years ago by VE3TP. He commented: "T were not exactly cheap to construct bu solved every receiver IM problem so fa (proving) that it is possible to produc ceiver input components which can today's requirements in relation to sens and high-level signal strength." Dr Rol reply to G4HRY's criticisms will be publi next month.



TECHNICAL TOPICS December1995
SWITCHING DIODES: DJ2LR/KA2WEUs REPLY

THE ITEM 'RF Switching Diodes Controversy 'TT, July 1995, included G4HRY's criticism of the advice given by Dr Ulrich Roinde, DJ2LR/KA2WIEU/4, in his excellent articles in OST that the second order IMD performance of several popular amateur HF transceivers could be improved by judicious substitution of PIN diodes, such as the Hewlett Packard HP5082-3081 , specifically intended as RF switching diodes. I pointed out that the criticisms were based solely on RF losses and that G4HRY had not made any IMD measurements. I added that I was sure that Dr Rohde could provide a convincing reply. However, in view of his experiences with GKPT's Omnii VI 1 felt it would be right to include G4HRY's view that it was unwise to put unquestioning faith in published articles including even those in OST and *RadCom.*

The detailed measurements provided by G3SBI (TT, November) and those published by DB1 NV in *VHF Communications* showed clearly that there is a wide difference between different diodes used for RF switching both in insertion loss and in IMD performance and that IMD is significantly affected both by the forward current through the diode and by frequency.

As a result of an unfortunate delay, the November item was written before I received a fax sent by Dr Rohde on July 18th. This, in a slightly abridged form, reads: I feel really concerned and sorry about G4KPT and the results of his experiments. As a matter of record, I would like to point out that intentionally
1 had not changed any of the diodes myself. but had the authorised service departments of AES, Milwaukee replace the diodes in the Yaesu FT890; ICOM changed the diodes in two IC765s; and Kenwood made the same changes in a TS50. The itemised ICOM repair bill shows 0.12uV for 12dB SINAD, I also had the other companies involved validate that following the diode changes, the receivers were within specifications.

'This validates my statement that this was a repeatable effort and the changes were not done at the expense of performance in any respect. It is also a matter of record that the HP5082-3081 diodes were used in the production of the Collins KWM380, one of which I still own and whose noise figure is on target with 0.3uV without a pre-amplifier and whose 2nd order IMD is superior to other diode applications. This should remove any doubts as to the correctness of my OST article.

1 have had no experience in modifying an Omni VI nor did I do any measurements or modifications with it. The ARRL edited in the Omni VI because it is a popular US-made transceiver and there had been some discussion as to whether or not the European version had different diodes or relays. Before fingers are pointed at specific diodes, I would like to examine the circuit diagram because there can be no need to change all 40 diodes. As an experiment, 1 may want to supply one set of more modem diodes.

"Everyone who has contacted me as the result of the OST articles had been advised not to use the HP 3081 (for reasons of cost and availability) but rather to use a Siemens BAR17 diode or M1204 diode, which is available through ICOM dealers/repair centres. Those diodes are much less expensive and more readily available.

"To the best of my knowledge, the companies who changed the diodes in the equipments involved did not change the diode bias. It is questionable why any one should wish to change diodes in the IF section; similarly diodes in the transmit / receive switches should not be touched.

"Finally, there is no question that relays provide the best of all worlds as far as IMD characteristics are concerned, but not necessarily the best solution in terms of space and costs. 1 have just tested a soon-to-be-re leased transceiver which uses PIN-type di odes and exhibits superb IMD characteristic while maintaining a good noise figure.

"As to multi-tone functionality, once 2n and 3rd order IMD tests have been done, on can predict the higher-order IMD effects, especially since they are based on diode characteristics and this type of test is a legitimate test to evaluate receivers.

"Hopefully, your readers will not deduct from this experiment that QST or other reputable magazines publish articles which are technically incorrect."

In a subsequent letter, dated September 19, 1995, Dr Rohde confirms that he has run into a lot of people who have modified their RF switching diodes and have been extremely happy with the results. Further, after refining his test set-up he finds the improvement is now slightly more dramatic than outlined in his QST article.

In regard to Dr Rohde's endorsement of the technical accuracy of articles, I would enter a caveat. While most writers strive lo complete accuracy. the mechanics an Murphy's Law of publication make it difficult to avoid some errors, particularly in column produced to a tight deadline. Many years ago I stressed that I regard Technical Topics as forum for new ideas, not all of which are likely to prove repeatable or even strictly accurate No guarantees can be given on experimental ideas still under development! I welcome comments from sceptical readers or those spotting printing errors etc. Fortunately, there is good evidence that the vast majority of 7T items do work as intended, and often provide useful additions to amateur lore!

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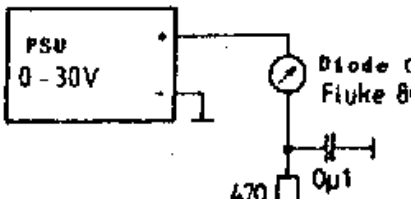
Intermodulation properties of switching diodes, by Dr. Ing. Jochen Jirmann, DB1NV

ZL4AI was contacted by a neighbouring ham, (known for many years). Peter Johnson ZL4LV.
peter.Johnson@Paradise.Net.Nz
Peter designed and developed from scratch in the early 1970s an HF transceiver. (Actually it is still under development and may soon have BA479s installed.) The local Branch of the New Zealand Amateur Radio Transmitters Association under Peter’s guidance sold this as a kitset. Peters design was the first use of diodes for band switching. Peter published this technique in English Radio magazines the early 1970s and thereafter the first commercial transceivers appeared with diodes switching bands. As the inventor of the concept Peter has collected articles on diode switches, and provided the following.

Dr. Ing. Jochen Jirmann, DB 1 NV

Intermodulation Properties Switching Diodes

Some attempts to improve the intermodulation properties of short-wave receivers were described in (1). It was demonstrated there that the main reason for the moderate intermodulation properties of many short-wave receivers should be looked for in the use of unsuitable switching diodes for the switching of the input band pass filters. Following numerous enquiries, the intermodulation behaviour of commercially a frequency switching dio ured in a second inves results were obtained us which were still almos ateur level, and should put down to the "dB comparison between diode types is actually tant than the absolute va



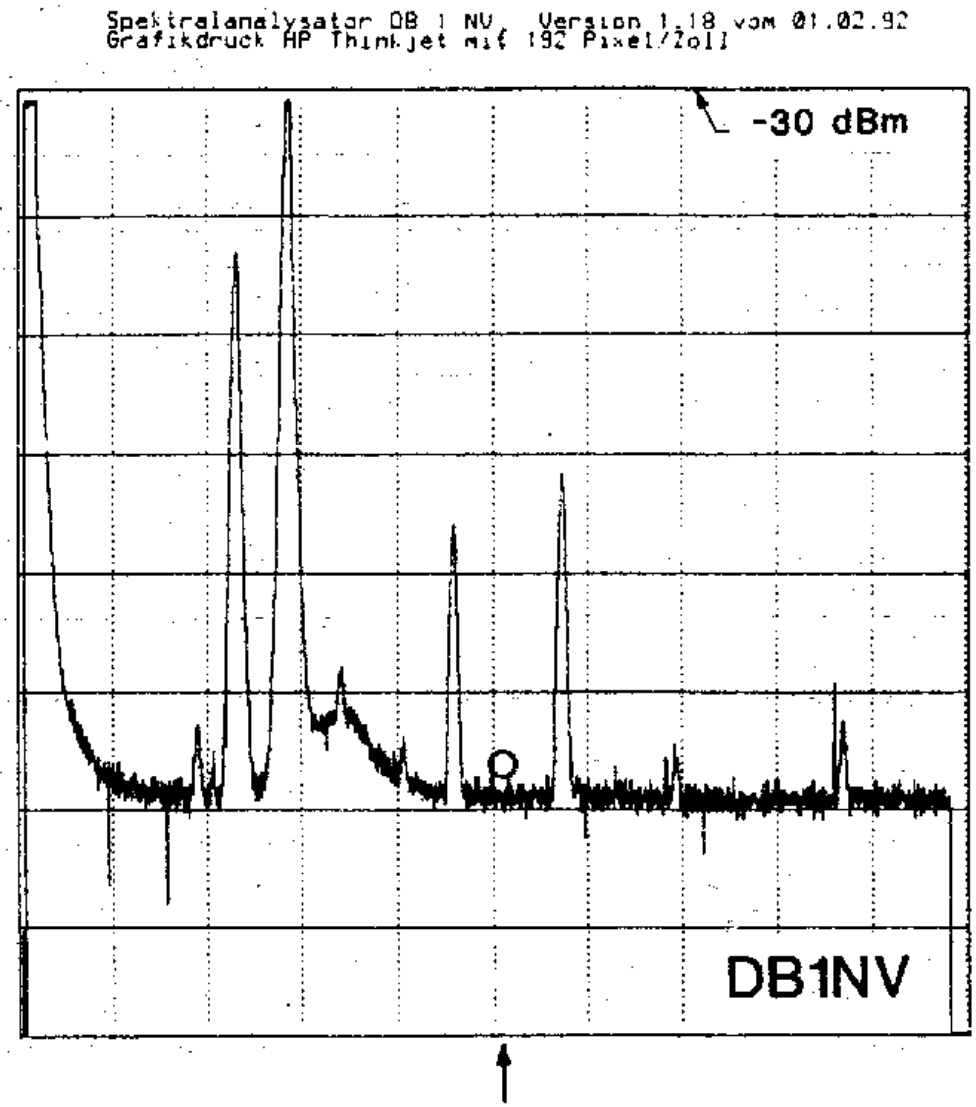


Fig.2:
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1.
THE MEASURING RIG

The previous experiments, using an IC765 from OM Hercher, DL8MX, had demonstrated that the critical level above which audible intermodulations arise should be sought at an aerial voltage of about 100mV. This corresponds to an output of -6dBm. By

frequencies, and the frequency was drawn up in such a w harmonics from the test transmi be separated from the IM sought. With some filters, a m ment dynamic range could be u about 90dB. The measuring sketched in Fig.1.

Two test transmitters act as sources, a Singer SG 1000 Hewlett-Packard 8640A, the ou

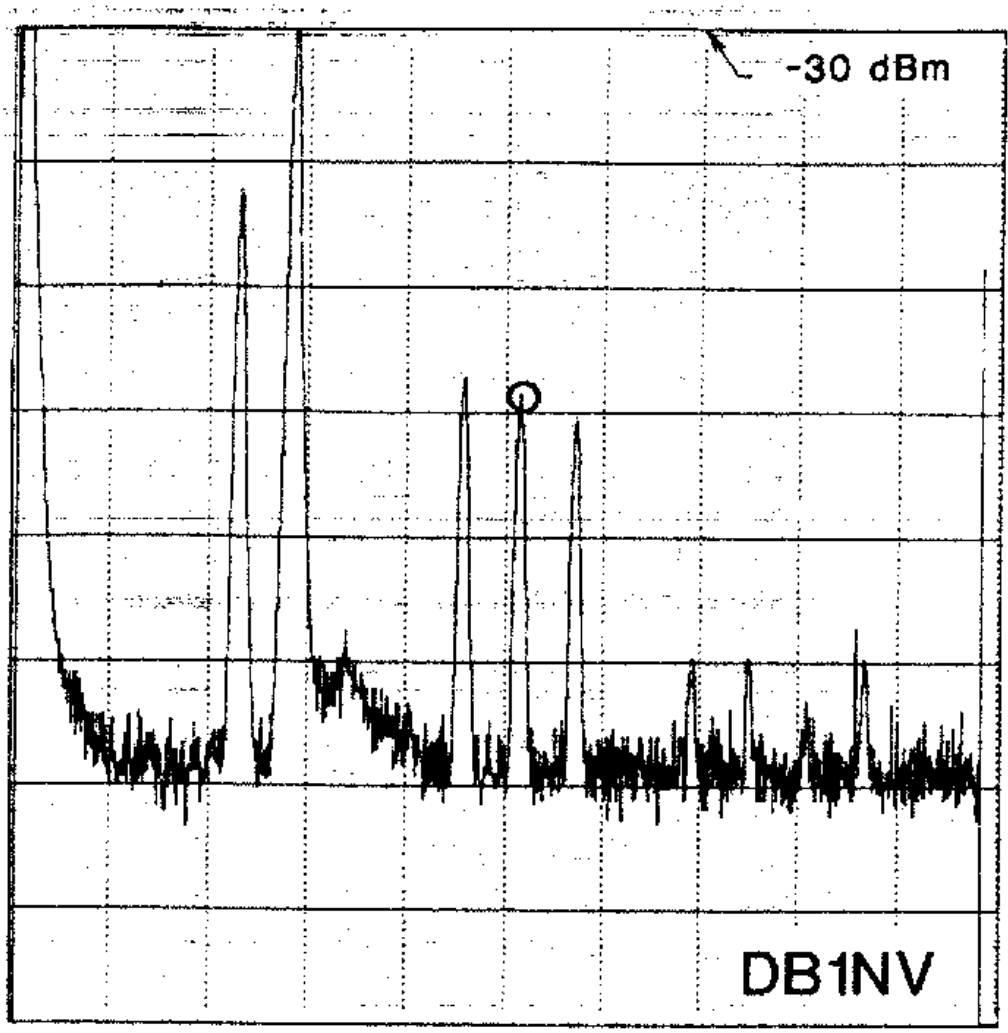


Fig.3: Measurement Cu IM2 Spectrum of BA379 with 2mA Current

lowed by the test diode, which is biased with adjustable DC. A high-pass with a limiting frequency of 20 MHz relieves the spectrum analyser (home-made by the author) of the strong carrier wave signals from the test transmitter. The analyser was set to an average frequency of app. 25 MHz and to 5 MHz/div.

For the measurement of total frequencies (second-order intermodulation), the test transmitters operated at

To measure third-order intermodu the test transmitters were set to 1 and 6 MHz and the mixed produc measured at 25 MHz.

To check the measuring rig, the was short-circuited. Fig.2 show analyser screen print-out. The tw transmitter signals can be recog (here 12 MHz and 15 MHz), to with their harmonics at 24, 30, 3 45 MHz. The reference level at t edge of the screen was -30dBm he

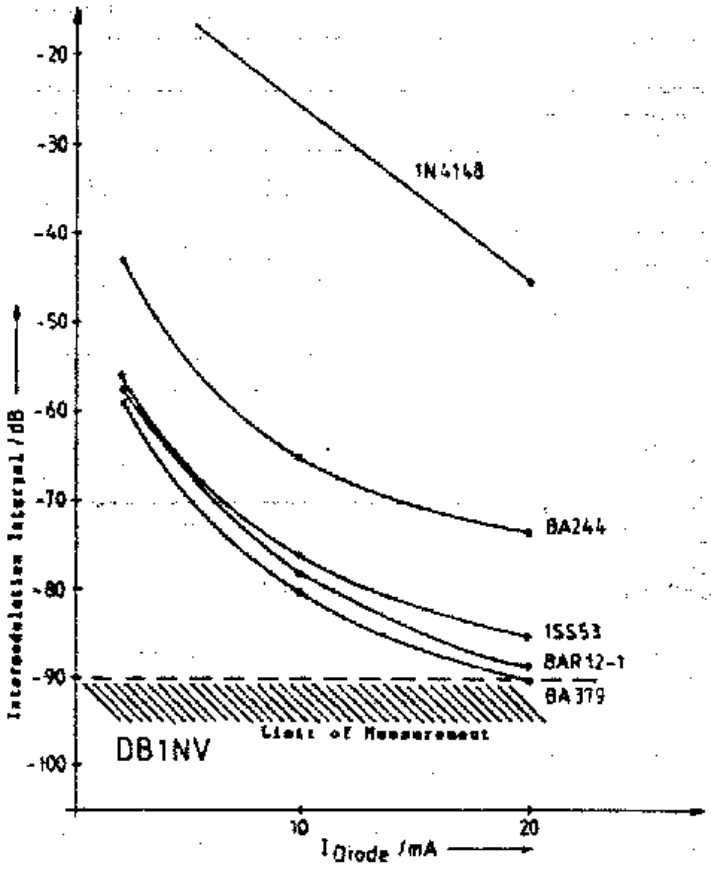


Fig.4: Second-order Intermodulation Products plotted against Diode Current

2. SECOND-ORDER INTERMODULATION

In this range, measuring frequencies of 12 and 15 MHz were used. The diode DC was varied from 2mA to 20mA. The test diodes used were a 1N4148, a 1SS53 (from an IC765), a BA379, a

various diodes are plotted aga diode DC in Fig.4. As can be s first round in the IM contest goe BA379 from Siemens, followed BAR12-1 and the 1SS53. Th cut-off results from the 1SS53 u diode are surprising. But sin diodes removed from the IC765 no type description, it might perh conceivable that ICOM had used improved diodes here. It isn from the parts list. It can cle seen how important a sufficient level of DC through the diodes i at current levels below 10m intermodulation products i greatly.

3. THIRD-ORDER INTERMODULATION

In this measurement range, th transmitters were tuned to 6 an MHz and the IM product was eva at 25 MHz. The diode DC was here at only two values, 2mA and and the same diodes were used Section 2. Fig.5 shows the in interference spectrum for the mea rig, Fig.6 the IM spectrum 1N4148 misused as a switching with a diode current of 5mA

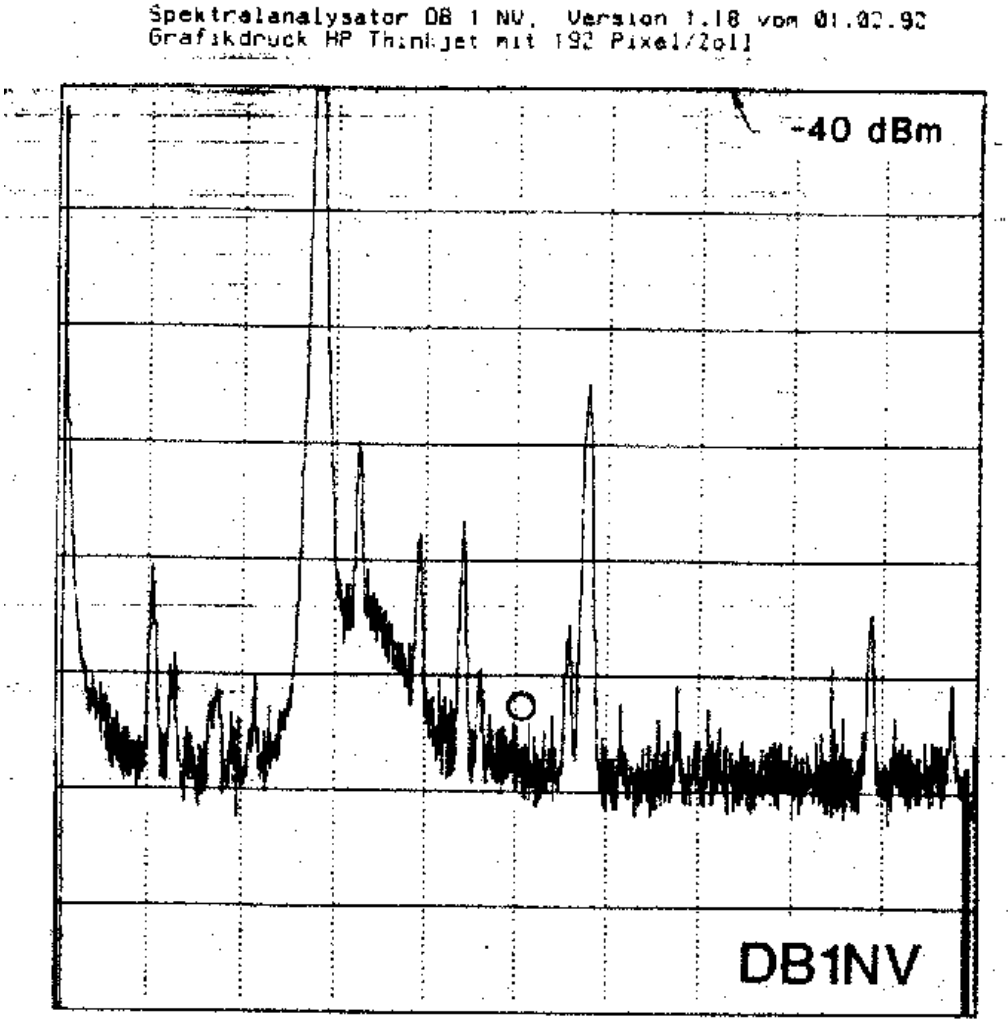


Fig.5: Measurement Cu without Diode (I measurement). Circle shows loca Intermodulation Product

4. SUMMARY OF RESULTS SO FAR

The measurement results listed essentially show four things:

- Good, repeatable intermodulation intervals can be obtained only through the use of "correct" PIN diodes, but they have their price. Miniature relays are even better, but more expensive and bigger.

(different production lines, di production methods).

- The relatively good cut-off obtained in practise from the a tus fitted with tuner swi diodes is not consistent wit poor measurement results fro BA244.

- The existing apparatus shoul be improved or re-construct order to check whether suf DC is flowing through the d

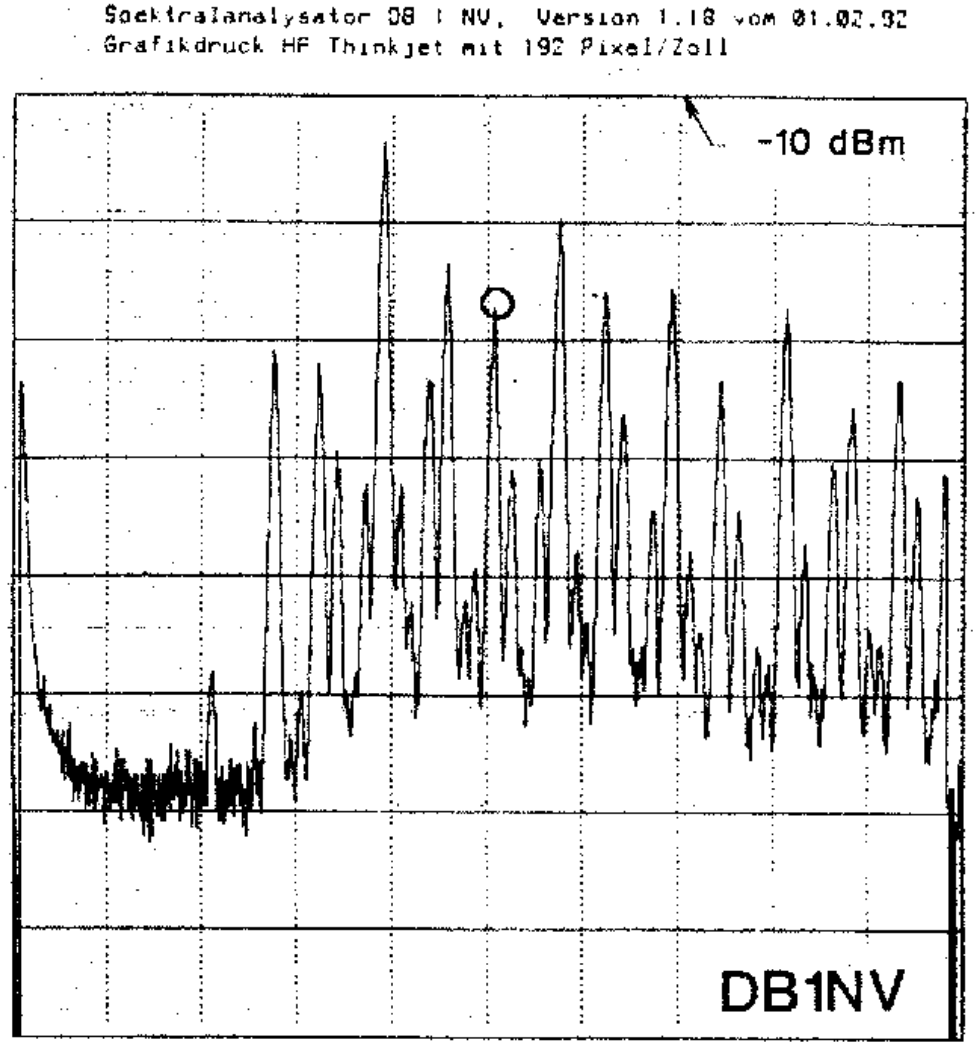


Fig.6: Measurement C IM3 Spectrum c 1N4148 with 5m Diode Current

But since over-modulated coils with ferromagnetic cores can also generate intermodulation effects, the same measuring rig was used to classify inductive components.

5. INTERMODULATIONS IN INDUCTANCES

Here both the aperiodic case (coil as

– With a choke effect, intermo products above -110dBm w detected either for rod core chokes from the Siemens M uge or for Neosid and TOKC made coils selected at randor the "VK200" six-bore core from Valvo or Philips Com a favourite with VHF Co cations readers, yielded an I of between 85 and 9 depending on the ferrite mat DC level of 50mA did not in

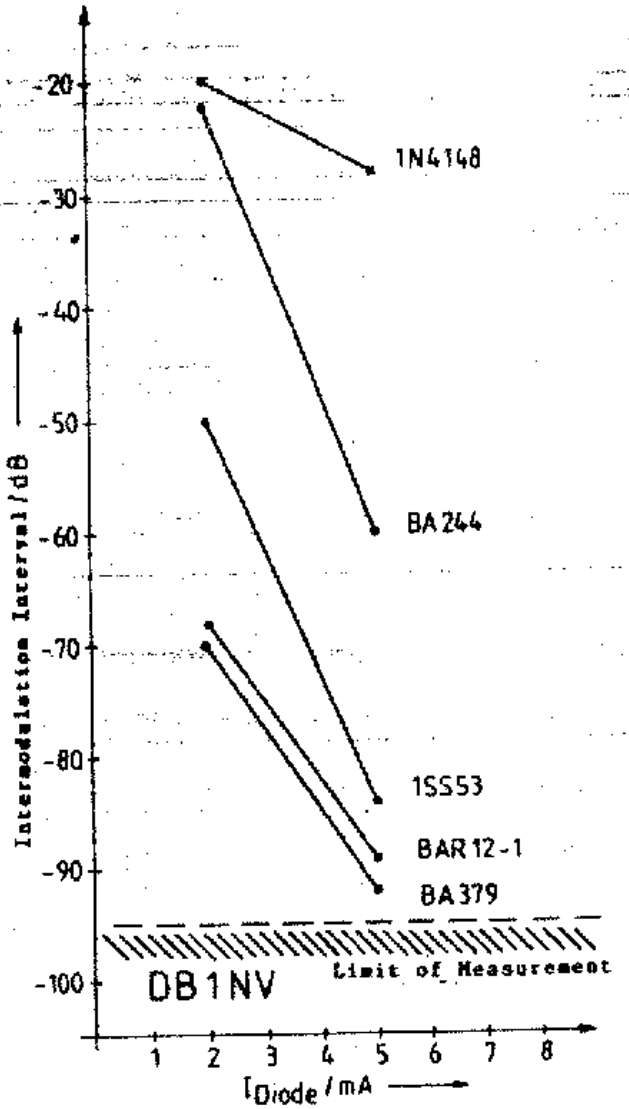


Fig.7: Third-order Intermodulation Products plotted against 2mA and 5mA Diode Currents

Amidon ring cores, suitable for short-wave use and of various sizes, were practically free from intermodulation.

The following design tips can thus be derived, some of which are in any case not new, but which have probably

2. In compact rigs, rod core ch such as the Siemens MCC, ca considered as alternatives.

3. Chokes in the filter structure, e the operating voltage feed, largely uncritical, as long as th not resonate.

In this connection, we might reca band-pass filters with ring core publicised many years ago by VI which were not exactly cheap to ruct, but on the other hand have s every receiver IM problem so far statement shows that, in spite of ments to the contrary from the in and from a few, probably unqua "specialists", it is possible to pr receiver input components whic meet today's requirements in relat sensitivity and high-level sign rength. Since in our hobby we need to worry about tenths of a like industrial manufacturers, w obtain results which are some ord magnitude better for a slightl creased cost!

The author hopes that this acco his measurements will start thinking about experiments of own, and would be pleased to r reports of their experiences.

6. LITERATURE

4.3: Summary of Key points on Purpose of Pin Diodes: [by ZL4AI]

- Diodes are inferior switches than relays.
- Diodes are used as a cheaper alternative to keep the cost of amateur radios down,
- Diode switches leak and cause adjacent transmit intermodulation signals on the air,
- Pin Diodes leak less and reduce intermodulation signals,
- Some Pin Diodes, notably the BA482 attenuate less radio signal. So in some instances, putting in replacement Pin Diodes in the receive path, up to the first mixer can increase the receive signal.
- It is good practice to bench test and verify whether a replacement Pin Diode does pass more signal than the existing diode.
- Note: The BA479 diodes [described below] according to their spec sheet have ” Wide frequency range 10 MHz to 1 GHz”: Possibly this means BA479 do not pass signal below 10 m Hz.
- BREAKING NEWS: DF5KF has just discovered, the BA479G attenuates less signal than the original TS-940 diode only at frequencies lower than 10 MHz. DF5KF is still testing and more information is to come. [See below]

4.4 Experience from Persons who modified the TS-940

First from www.contesting.com

TopBand: : [WSVHF] TS-940 Specs
km1h @ juno.com mailto:km1h@juno.com
Thu, 05 Mar 1998 10:30:41 EST

To all those on Topband who asked...here is the results of the TS-940 tests.

73 Carl KM1H

--------- Begin forwarded message ----------
From: km1h@juno.com (km1h @ juno.com)
To: wsvhf@qth.net
Subject: [WSVHF] TS-940 Specs
Date: Tue, 09 Sep 1997 22:35:15 EDT
Message-ID: <19970909.214104.9687.15.km1h@juno.com>

As an addition to the Sherwood receiver info, here are some specs on a TS-940.

All tests were run on 28MHz during the past few days on a customers unit.

TS -940 late serial # with factory phase noise updates:
MDS SSB -135 dBm
MDS CW cascaded 500Hz filters -137 dBm
Sensitivity 10dB S+N/N .12uv
Phase Noise -131dBc at 10 KHz
Filter rejection CW >90 dB
2 tone dynamic range Wide 95 dB @ 20 KHz
2 tone dynamic range Narrow (CW Filters) 77 dB @ 2 KHz
3rd Order IP +1dBm at 20 KHz
Wide Band transmitted noise -75 dB below full carrier

The same TS-940 but with PIN diode mods to RF and IF boards:
MDS SSB -137dBm
MDS CW -142 dBm
Sensitivity ~ .1uv
Phase noise -131 dBc @ 10 KHz
Filter rejection (CW) >90 dB
2 tone Dynamic Range Wide 102 dB @ 20 KHz
2 tone Dynamic range Narrow (CW Filters) 83 dB @ 2 KHz
3rd Order IP +5 dBM @ 20 KHz
Wide band transmitted noise -90 dB below full carrier

A few notes and comments:

Although the PIN diode improvement is evident in the numbers the audible difference
First of all the receiver is noticeably quieter. The IMD performance shows an "appar
about 10-12 dB under crowded band conditions. This follows along with conversations
Rhode several years ago when I first started using PIN diodes. The cumulative effect
The receiver is a pleasure to use in lowband pileups now.

The improvement in wideband TX noise is due to, I believe, the use of PIN's in those
common to TX and RX on the IF board. The stock diodes either generated noise or allo
into the TX path. The same appears to hold true in the opposite scenario. This TX no
was recently made aware of by a local on 6M and bears closer examination and possibl
improvements. The noise does not change dB levels when going from full power to the
transverter port so it can not be blamed on thermal noise in the subsequent linear a

Magazine reviews of the TS-940 were of early production. Kenwood at first refused to
problems. They then went thru two different mods before they were satisfied. The imp
and late models is about 15 dB.
Serial numbers in the mid 8 Million group and up had factory mods.
Kenwood Service Bulletin 917 may be retrofitted to the earlier radios. It
is a fairly simple mod.

Other KW radios such as the TS-850 and TS-930 could also benefit from PIN mods. They
ports and are quite reasonably priced on the used market.

I cant speak for other brands but a quick review of a few Service Manuals shows an a
across all brands with respect to diode switching schemes.

73....Carl KM1H
----- Submissions: wsvhf@qth.net Subscription/removal:
wsvhf-request@qth.net
--------- End forwarded message ----------
==========

-----Original Message-----

From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Wednesday, 27 April 2005 10:42 a.m.
To: jaking@es.co.nz
Subject: RE: ts-940

Hi Jeff,
thank you for your reply and congrats for the informative web site. I read about the PIN diode mod in a web message.
I replaced diodes D9 through D20 of the RF board by the PIN types BA479. I did not replace D3-D8 because these
switch a frequency too low for the BA478 to be an effective PIN. I checked the BA478 and found them to be good at frequencies above 2 to 3 MHz. The BA479 have been offered in different versions and it is important to use those
which are designed for HF (not VHF). Certainly, other PIN diodes may also be useful. The IMD of my 940 improved by
about 5 dBm after this mod.

For re-alignment of the receiver, I mainly followed the instructions of the service manual for the RF and IF
amplifier stages (I did not align oscillator and PLL circuits). I have a sweep generator (Rohde & Schwarz SWOB 5
equipped with log amplifier), which was very helpful to optimise the bandpass filters on the RF board.

I established RX sensitivity with a HP8640B RF generator together with a home made audio voltage detector to
determine an audio increase by 10 dB. I have two of the HP8640B, so that I am able to determine receiver IMD.
The HP8640B are quite famous, since they produce a very clean RF signal and are sold at a reasonable price.

By the way, I own two TS940 and use one of them for experimental modifications which are more ´critical´, so
that I would not really recommend others to reproduce them. If you are interested anyway, I will report on that
later. It’s past midnight now.

73 for today,
Thomas

>From: "Jeff King" <jaking@es.co.nz>
>Reply-To: <jaking@es.co.nz>
>To: <thomas_hohlfeld@hotmail.com>
>Subject: RE: [ts-940] Re: Why don't more people use this group?
>Date: Mon, 25 Apr 2005 09:09:42 +1200
>
>Thomas
>
>I found your review of the FETS most interesting.
>My reason for writing is to ask you to tell me more about the pin diode modifications you have undertaken.
>Where are these diodes and what do you do to replace them?
>What else did you do to realign receive?
>How did you establish the 0.15 uV sensitivity.?
>
>Yours sincerely
>Jeff King ZL4AI

==========

>From: "Jeff King" <jaking@es.co.nz>
>Reply-To: <jaking@es.co.nz>
>To: <jaking@es.co.nz>
>Subject: RE: ts-940
>Date: Fri, 29 Apr 2005 17:05:30 +1200
>
>Hi Tom,
>
>Thanks this information is very interesting.
>I really appreciate your advice on aligning the 940 very helpful information.
>
>I also read [below] about pin diodes being changed in the IF board RX / TX circuits. Have you tried changing any of those?
>
>Is the Temic's- Vishay (former Telefunken) BA479 (G or S suffix) a suitable diode? Spec sheet attached.
>
>Yours sincerely
>Jeff King ZL4AI
>
>

-----Original Message-----
From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Monday, 2 May 2005 9:23 a.m.
To: jaking@es.co.nz
Subject: RE: ts-940

Hi Jeff,
Thank you for the comments on the pin diodes. Yes, I used the BA479G. These were quite inexpensive and it was
easy to obtain them when I did this mod two years ago. Today, I checked for a source in the internet
and found a German distributor who may still have the BA479G. Check at
http://www.schuricht.de/w3a/default.asp (a button at the lower left will switch language into English).
They do not look too expensive (0.31 Euro when 50
are ordered).I checked the BA479G with an RF generator and scope and found it to be good at 7 MHz and
higher. I am not sure if it is very effective at 3.5. Nevertheless, I decided to replace D7 through D20
on the RF board. I think I also exchanged D21 (don’t know any more, but makes sense). I did not change
D23 and D26 in the preamplifier because these probably are already pin diodes and their exchange might
impair the AGC characteristics. There are some switching diodes also in the IF section of the 940, but I
did not replace these, because XF-1 already cuts the bandwidth at the front of the IF amplifier and
there may not be too much intermodulation behind. May be I will do this later when I have to take out the
IF board for some other reason.

I told in my last mail that I did other mods in my 940s. It may take quite long to describe them all, so
for the first time here is a short list:

(1) I exchanged the PLL amplifier IC (IC18, PLL board) into a pair of extremely low noise OPamps,
which lowered phase noise. However, this required to tackle some problems with PLL instability.

(2) I have the optional 250 Hz CW filter for the 455 kHz IF. When working PSK in SSB mode, I missed the
possibility to activate this filter. I found out how to modify the 940 to allow for activation of the
CW filter in SSB, including the control LED at the narrow CW filter switch.

(3) When I bought my first 940, it came without the AT unit. So I built one with an automatic antenna tuning
board (kit) and built an interface which nicely communicated with the antenna tuning control circuit of
the 940. Later, I got the original AT-940.

(4) Follow hyperlink
VOLTAGE_REGULATOR_HEAT_UP_AND_BFO_SHIFT

(5) I equipped my 940s with the piexx boards which allows to control the 940 via the serial interface of
a PC.

Best 73s for today, Jeff

Thomas, DF5KF
==========

The following 2 emails have had some irrelevant content edited out.

>From: "Jeff King" <jaking@es.co.nz>
>Reply-To: <jaking@es.co.nz>
>To: "'thomas hohlfeld'" <thomas_hohlfeld@hotmail.com>
>Subject: RE: ts-940
>Date: Fri, 27 May 2005 19:35:16 +1200
>
>Hi Thomas,
>
>Thanks for your email which I am still thinking about, a lot.
>
>Anyway I have been trying to get BA479G diodes from
>a supplier.
>
>The supplier advises they have the BA479 but cannot tell if it is a G or S.
>I have asked them to put a resistance meter on it and await those
>results. [They replied they could not help.]
>
>Attached you will find the datasheet. As you can see on the second
>and third lines on the first page
>Reverse impedances are:
>G: 5 k Ohms
>S: 9 K Ohms
>
>It appears to me that the S might be better, or no worse than the G.

>
>Do you think S would be suitable to use without further testing.
>My worry is installing an S and finding it does not work well.
>
>I have an interesting article from Radcoms Pat Hawker on Pin Diode
>replacements in July 1995. If you would like this I will send that when
>I have it scanned. This article explains that the BA482 replaced in the
>Omni VI with the HP 5032-3081 resulted in impaired performance because
>the HP put through 0.5 dB less signal.
>
>
>Your sincerely
>Jeff King

-----Original Message-----
From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Tuesday, 31 May 2005 9:15 a.m.
To: jaking@es.co.nz
Subject: BA479 etc.

Hi Jeff,
Thank you for your mail and your thoughts on the PIN diode mod. Yes, you are perfectly right in that this mod will probably be a tradeoff between linearity and a slight loss of sensitivity. I would be very interested to read Hawker´s article you mention.

Your mail also made me re-think about this mod. The G version of the BA479 has been suggested to be better for short wave purposes, but it is true that there is not much evidence in the datasheet. My guess is that the BA479 should simply be measured in a test setup, and this is what I started yesterday.

I set up a simple circuit with two RF generators (300 mV out) fed into a hybrid combiner, the output of the combiner going into one end of the diode under test. The other end of the diode was coupled via a step attenuator into a spectrum analyser (my shack is a museum of old instruments, hi). I fed a forward current of about 10mA through the diode, uncoupled from RF of course. The generators were adjusted between 2 and 15 MHz, always 500 kHz apart (two tone signal).

I hadn’t much time and did only some very short measurements. Anyway, the results were interesting. Here they are:

1. A conventional all-purpose diode (1N4148) produced a horrible spectrum of intermodulation products. In addition, the insertion loss was high (up to 10 dB).

2. Next, I inserted one of the original diodes which I replaced in my TS-940 (of course I did not through them away). The difference was impressing. At 10 MHz and above, these diodes produced very little intermodulation distortion with very low insertion loss (1 dB or so). Below 10 MHz, the intermodulation became worse and was poor at 3.5 and below. Interestingly, insertion loss moderately increased below 7 MHz (reaching 3 dB at 3.5).

3. I also tried a BA479G which I left from another project. These produced very low intermodulation signals, even below 2 MHz (which surprised me). At 10 MHz and above, the BA479´s have a slightly higher insertion loss than the

original Kenwood diode (1-2 dB worse). Below 10MHz the BA479 showed less (!) insertion loss and were clearly superior with respect to intermodulation.

To summarize, the BA479G is better than the original TS-940 diode only at frequencies lower than 10 MHz. As you will imagine, I am thinking about returning to the original diodes at 10 MHz and above. It may take a couple of weeks until I will have time.

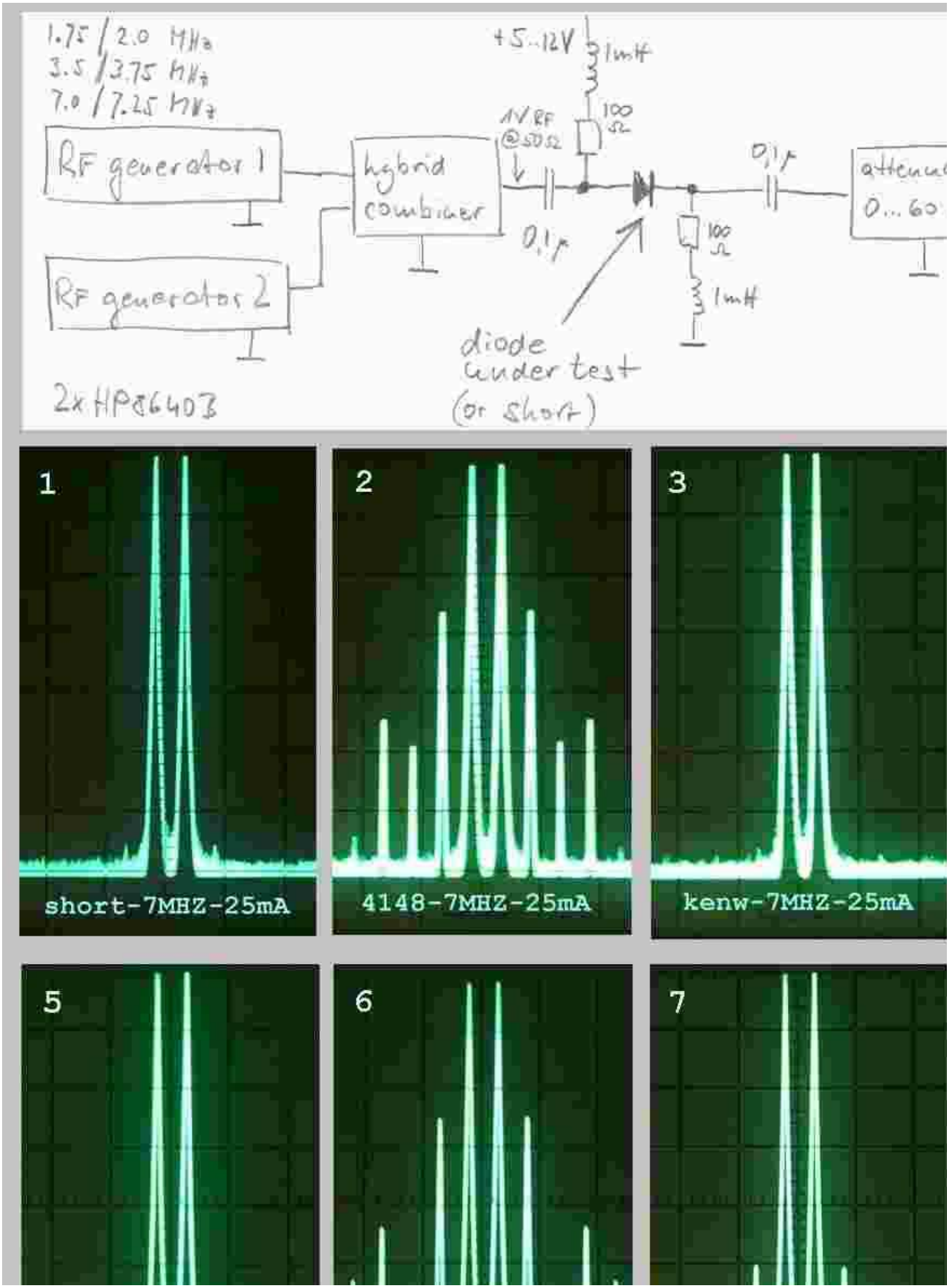
I can also take some digital photographs of the intermodulation spectra and mail them to you, if you are interested (may take 2-3 weeks). Let me know if your e-mail server has limitations in file size.

Best regards for today and vy 73,
Thomas,
DF5KF

-----Original Message-----
From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Friday, 10 June 2005 8:56 a.m.
To: jaking@es.co.nz
Subject: RE: BA479 etc.

Hi Jeff,
thank you very much for including these excellent articles on the web page.
It’s so useful that I’ll print it out.

Now, here is part #1 of my measurements on the RF properties of the 940 Front end diodes. To start, I concentrated
on the diodes in front of the filters (diodes # 3, 5, 7 ... 19), which see the whole RF spectrum from by the antenna.
The forward current of these diodes is 25 mA in my 940, which appears quite a lot, but probably was chosen because
the diodes need to be very linear here.
The attached file (25mA-all.jpg) shows the schematic test setup on top. I already described it in my previous mail,
but this time I measured at a ´realistic´ diode current of 25 mA. The two RF generators were set close to 7, 3.5 and
1.75 MHz, always 250 kHz apart. The spectra (figs 1-12) show the two carriers at the center. All additional peaks are
3rd and higher order products, indicating the non-linearity of the diodes. To get an ´ideal´ reference, I also
measured with the diode replaced by a wire bridge (figs 1, 4 and 8). Here, the low remaining 3rd order signals
(less than -60dB) reflect some non-linearity of my test setup (my homemade hybrid combiner may not be perfect).
As I already noticed in my earlier mail, a general purpose diode (1N4148) produced a horrible spectrum of side
products at all three bands (figs 2, 6, 10). The original Kenwood diode (1S2588) was very good at 7 MHz (and at
higher QRG´s, not shown), but worse at 3.5 and quite poor at 1.75 MHz (figs 3, 7, 11). In contrast, the BA479G
was very good and provided the least side products (figs 4,8,12). If you look closer at the distance of the carriers
from the top graticule (sorry, background is quite dark), you will notice that the carrier attenuation of the BA479 is
low at all bands and not much different from the original Kenwood diode.


1.75 / 2.0 MHz
3.5 / 3.75 MHz
7.0 / 7.25 MHz
RF generator 1
RF generator 2
2x HP8640B
hybrid combiner
+5..12V
1mH
1V RF @50Ω
100 Ω
0,1µ
0,1µ
100 Ω
1mH
diode under test (or short)
0...60
1
short-7MHZ-25mA
2
4148-7MHZ-25mA
3
kenw-7MHZ-25mA
5
6
7

Part #2 of my measurements will follow, where I studied the diodes behind the input filters (D4,6,8...20 and D21)
which are run at a lower forward current. The measurements are already finished but the figures need to be arranged.

Good luck for today!
Thomas
DF5KF

-----Original Message-----
From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Monday, 13 June 2005 4:31 a.m.
To: jaking@es.co.nz
Cc: hohlfeld@uni-duesseldorf.de
Subject: TS-940S - pin diode part#2 and some other considerations

Hi Jeff,
here comes part #2 of the pin diode measurements, which concentrates on the diodes between the bandpass and the preamplifier of the TS-940.

First a short comment on the 940´s front-end: when the RF has passed the RX bandpass, three diodes follow before the signal reaches the preamplifier Q10. Of these, two are switching diodes (one of D6,8 ... D20, D21), while one (D26) is a pin diode. Only the two switching diodes are candidates for replacement. For test purposes, I assumed that D26 is fully open and D23 closed (AGC at highest sensitivity). In this case, we deal with two switching diodes in series. They are also in series with respect to their forward current, which is determined by R31. I measured 17 mA in my TS-940. The impedance, which these diodes see, is also important. I estimate it about 50 Ohm, because the bandpass filters of the TS-940 are constructed symmetrically.

Therefore, my test setup was similar as before with the following changes: (1) I tested two diodes in series, (2) I used a forward current of 17mA and (3) I also measured at 10.1 MHz. Because the 1N4148 was so poor in part#1, I did not consider it further. The attached jpg file again contains a plot of the test setup.

Here are the results (see attached jpg file): At 10.1 MHz (figs 1-3), the original Kenwood switching diode (1S2588) is as good as the pin diode BA479. The same also applies to higher frequencies, which I do not show here. The insertion loss of the two BA479 in series is slightly higher than that of two Kenwood diodes, but is still less than –1 dB (more on this below). At 7 MHz (figs 4-6), the 3rd order products are clearly increased by the Kenwood diodes (fig 5) in comparison with the reference (diodes shorted, fig 4). The BA479 (fig 6) is clearly better than the Kenwood diode, although a minimal increase is also seen compared with the reference. At 3.5 MHz the Kenwood diodes generate a lot of intermodulation products (fig 8) and the BA479 (fig 9) is obviously superior. The same is true for the 1.75 MHz band (figs 10-12). In summary, the BA479 is better than the original Kenwood switching diode at 7MHz and the lower bands at a forward current of 17mA. There is no relevant difference at 10 MHz and higher.

It would also be interesting to know how the diodes behave at frequencies below 1.75 MHz. Unfortunately, my combiner is not appropriate for a lower

QRG. But I compared the generation of harmonics by the Kenwood diode and the BA479 at lower frequencies and found the BA479 still to be better than the Kenwood diode even at frequencies down to 100KHz.

The above measurements also show that the BA479 has a slightly higher insertion loss than the Kenwood diode. This is a well known disadvantage of pin diodes (also adressed in the excellent articles on your web page). In the case of the BA479, however, the effect is less than –1dB and therefore probably negligable in the 50 Ohm system of the TS-940. To confirm this, I also used a dB meter to determine the insertion loss of two Kenwood diodes in series compared with two BA479 in series. At 17 mA diode current, two Kenwood diodes produce a loss of -0.2dB at 1.75 and -0.1 dB at 3.5 though 28 MHz. Two BA479 in series cause a loss of –0.8 dB at 1.75 and 3.5MHz and -0.7dB at 7 through 28MHz. So there is a clear difference, but probably without much importance.

What are the consequences? As long as a broadband antenna feeds the TS-940, the front-end before the bandpass (diodes D3, D5... D19) will probably be improved by changing into suitable pin diodes, such as the BA479. Those who use the TS-940 only with a beam antenna (e.g. 20-10m), which is unlikely to deliver large signals at 80 and 160m, will probably not have much benefit. The two switching diodes between the bandpass filters and the preamplifier may also be replaced by pin diodes at the lower bands (D6, D8 ... D14 and D21). I would not recommend to exchange D16, D18 and D20, because the original diodes are already excellent at the higher bands and the pin diodes would add nothing else than a (minimal) increase of insertion loss.

In addition to the front-end diodes, there are also numerous switching diodes in the IF unit. Particularly those before the 8MHz crystal filters may be considered for replacement by pin diodes. I can imagine that this will improve narrow-band intermodulation. I'd be curious if anybody else has experience with this. If not, I may check out this point in future.

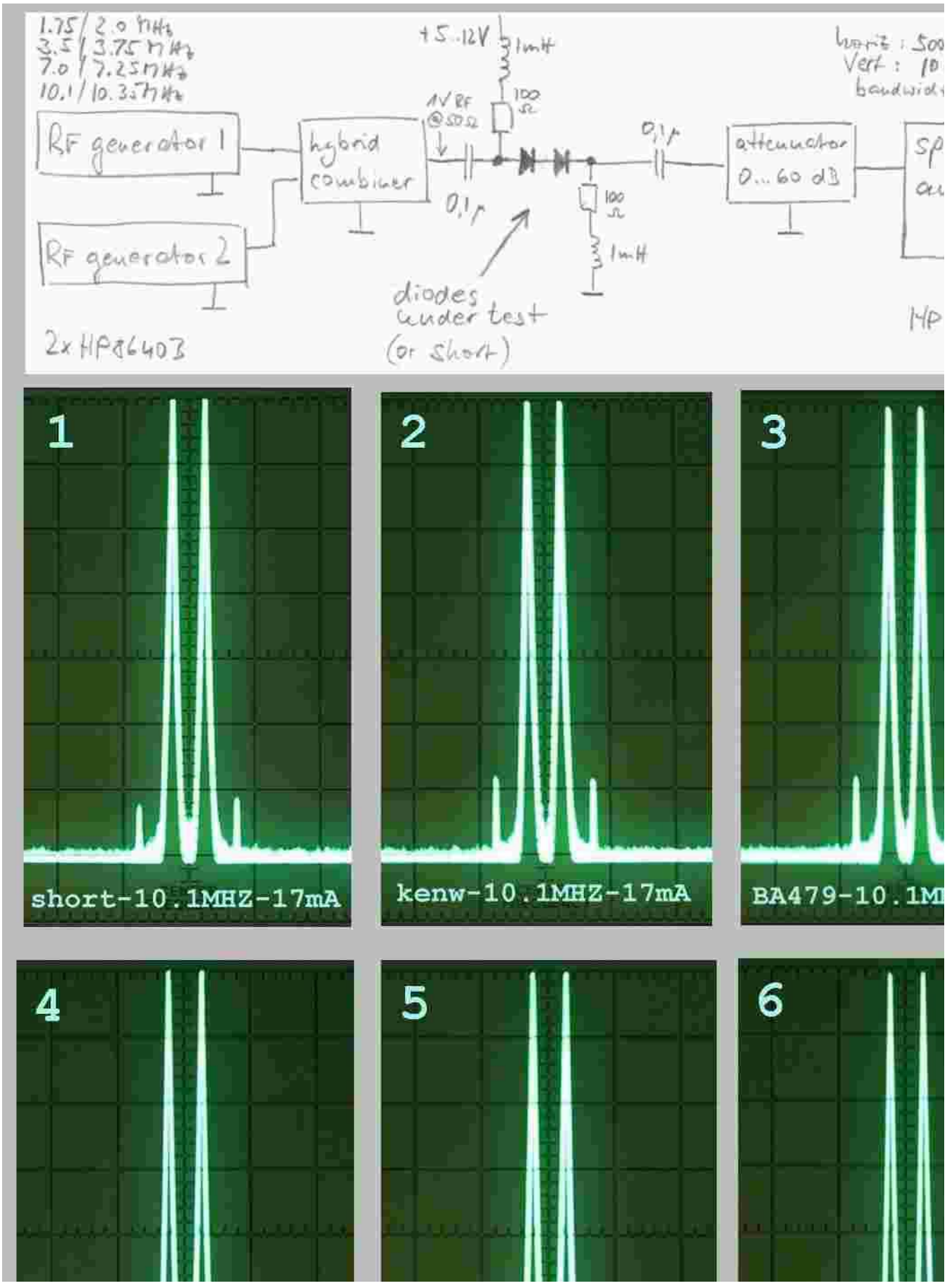
Your last mail says you ordered 40 BA479 diodes, so it seems you found a source. I for myself also ordered 50 BA479 from Schuricht, here in Germany. It's good to have some on stock for future projects and people say these parts are likely to be replaced by SMD types in future. If you still need BA479, let me know and I will try to help. By the way, there are probably excellent alternatives. The TS-940 uses in its front-end an attenuation pad which is part of the AGC (D23 and 26, MI204). I tested these and found they are even a little better than the BA479. The problem with these is that they are hard to obtain.

Thank you for mailing the discussion on the reversed Q10/Q4 problem. Although I was unable to find a difference in my test setup (as I reported earlier), it is certainly possible that there is an asymmetry of the internal capacitances that did not become apparent in my measurements. I think I should try out this mod and do some measurements, but it may take a little until I'll have time. It would also be interesting to see how the increase in sensitivity, if it really occurs, will change the receiver's dynamic range.

Finally, my congratulations for your exciting web page! You did a very good job in digging out all the fascinating information about and around the TS-940. It's a pleasure to contribute.

Best regards,

Thomas
(DF5KF)


1.75 / 2.0 MHz
3.5 / 3.75 MHz
7.0 / 7.25 MHz
10.1 / 10.35 MHz
+5..12V
1mH
100 Ω
1V RF @ 50Ω
RF generator 1
hybrid combiner
0,1µ
attenuator 0...60 dB
RF generator 2
100 Ω
1mH
diodes under test (or short)
2x HP8640B
1
short-10.1MHZ-17mA
2
kenw-10.1MHZ-17mA
3
BA479-10.1M
4
5
6

4.5 : Pin Diode Modification for TS-440

A similar sort of mod for the TS-440 maybe found at:
http://www.mods.dk/view.php?ArticleId=1709
==========

4.6: So summary of Pin Diode Modification

Until further research verifies otherwise, only replace (odd numbered) diodes that carry less than 10 MHz. [Above 10MHz BA479 has more attenuation than the Kenwood 1s2588, so leave the original 1s2588 in place.] It maybe better to hold off any replacement until research is completed.

> -----Original Message-----
> **From:** Jeff King [mailto:jaking@es.co.nz]
> **Sent:** Monday, 13 June 2005 9:53 p.m.
> **To:** 'thomas hohlfeld'
> **Subject:** RE: TS-940S - pin diode part#2 and some other considerations
>
> Hi Thomas,
>
> Thanks for this.
> Just to verify I understand you correctly.
>
> At 17 ma you advise
> ==========
> The above measurements also show that the BA479 has a slightly higher insertion loss than the Kenwood diode. This is a well known disadvantage of pin diodes (also addressed in the excellent articles on your web page). In the case of the BA479, however, the effect is less than –1dB and therefore probably negligible in the 50 Ohm system of the TS-940. To confirm this, I also used a dB meter to determine the insertion loss of two Kenwood diodes in series compared with two BA479 in series. At 17 mA diode current, two Kenwood diodes produce a loss of -0.2dB at 1.75 and -0.1 dB at 3.5 though 28 MHz. Two BA479 in series cause a loss of –0.8 dB at 1.75 and 3.5MHz and -0.7dB at 7 through 28MHz.
> ==========
>
> so Jeff King concludes that
> Two BA479s at 17 ma show

-0.6 dB more insertion loss at 1.75 MHz
-0.7 dB more insertion loss at 3.5 MHz
-0.6 dB more insertion loss at 4 MHz through to 28 MHz

This means the BA479 will reduce the signal and therefore will not improve the receiver performance. In Jeff's opinion this is considerable increase in loss of receiver performance, and not really viable to use a BA479 as a replacement.

Transmitter performance between 1.5 and 7 MHz will improve because of the much better BA479 IMD performance you describe.

On 31-5-2005 Thomas advised at 25 ma
==========
3. I also tried a BA479G which I left from another project. …… At 10 MHz and above, the BA479´s have a slightly higher insertion loss than the original Kenwood diode (1-2 dB worse). Below 10MHz the BA479 showed less (!) insertion loss and were clearly superior with respect to intermodulation.
==========

This means the only diodes that should be replaced are
D13, D11, D9, D7. in operating at 1.5 MHz to 8.5 MHz and 25 ma

D5 and D3 operate at less then 1.5 MHz, and the performance of the BA479 is unknown in that region.

I wonder if you could document the actual insertion loss of a BA479 performance at 25 ma between 1.75 MHz AND 10.0 MHz?

I look forward to your reply.
Yours sincerely
Jeff King

Diodes on RF board	Original Kenwood Diode	Original Spec	Operating Frequency MHz	Replacement	Replacement Spec
D3	1s2588 [(L30) DIODE TW-4000A, $3.15]		~0.5	Don't replace until testing verifies suitability	
D4	1s2588		~0.5	Don't replace BA479 -0.3 dB loss is too great	
D5	1s2588		0.5-1.5	Don't replace until testing verifies suitability	
D6	1s2588		0.5-1.5	Don't replace BA479 -0.3 dB loss is too great	
D8	1s2588		1.5 -> 3.0	Don't replace BA479 -0.3 dB loss is too great	
D10	1s2588		3 - 4	Don't replace BA479 -0.35 dB loss is too great	
D12	1s2588		4 - 7	Don't replace BA479 -0.3 dB loss is too great	
D14	1s2588		7 - 8.5	Don't replace BA479 -0.3 dB loss is too great	
D7	1s2588		1.5 -> 3.0	PIN type BA479	SI-D 30V 50mA 100MHz
D9	1s2588		3 - 4	PIN type BA479	SI-D 30V 50mA 100MHz

D11	1s2588		4 - 7	PIN type BA479	SI-D 30V 50mA 100MHz
D13	1s2588		7 - 8.5	PIN type BA479	SI-D 30V 50mA 100MHz
D16, 15	1s2588		8.5 - 14	don't replace BA479 has 1 - 2 dB higher insertion loss than 1s2588 > 10MHz	
D18, 17	1s2588		14 - 20	don't replace BA479 has 1 - 2 dB higher insertion loss than 1s2588> 10MHz	
D20, D19	1s2588		2 -- 30	don't replace BA479 has 1 - 2 dB higher insertion loss than 1s2588> 10MHz	
D21	1s2588		2 -- 30	don't replace BA479 has 1 - 2 dB higher insertion loss than 1s2588> 10MHz	
D26	MI204	Pin Diode	2 -- 30	don't replace BA479 has 1 - 2 dB higher insertion loss than 1s2588> 10MHz	

Whether you install many pin diodes depends on how crowded the bands are at your location.
More information below explains this:

-----Original Message-----
From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Tuesday, 21 June 2005 9:16 a.m.
To: jaking@es.co.nz
Subject: RE:

Hi Jeff,
yes, I think that 0.3-0.4 dB is almost nothing. Remember that one S unit makes 6 dB (20-fold more!). The additional loss caused by the pin diodes therefore is a very small fraction of an S unit. A few meters of RG58 antenna cable with conventional plugs cause more attenuation than these pin diodes.

By the way, I also measured the attenuation between the TS-940 antenna plug and the preamplifier input. All frontend switching diodes plus the relay contacts plus the bandpass filters (14 MHz) have an attenuation of 2 dB. The same measurement with my Icom IC751 was 5 to 6 dB. This shows that the TS940 is indeed an excellent construction.

Based on the results of my pin diode measurements I have now replaced most of the switching diodes with BA479G. The only exception are D20, D18, D16 and D14 which I did not change. With this change (plus turning around Q10), the RX sensitivity (MDS) is -135 dBm, an excellent result fully competitive with the top Rigs marketed today.

Best regards,
Thomas

From: Traian Belinas [mailto:traian.belinas@deck.ro]

Sent: Monday, 20 June 2005 10:29 p.m.
To: jaking@es.co.nz

Subject: Re: pin diode, reversed FET
Hello Jeff,
0,35 dB is an INSIGNIFICANT amount of loss, it is even dificult to detect a such low difference....
The positive aspect of the reduced IMD (especially the second order IMD reduction) is by far more important than the little loss.
My only doubt in such case is the parts and labour cost, and if the mod is really needed for you there.
If you consider it as being needed (if you have unwanted strong signals at your QTH, and please consider the broadcast bands also), **then go for this mod with confidence.**
Thomas is right, the lower bands are really crowded here, especially during the evening. You are a lucky OM being there in ZL...
After 22.00 local time, the 80m band is full here, I can hear even the italian and DL stations making local QSO's with other I and DL stations there respectively and having some big signals, as not to mention the russians which are everywhere and really strong, like locals, and S9 + 30 to 40 dB signals are usual. The thousands of GU43, GU74 and GS35 power tubes are really put to work out there, hi.
In my case, the added city QRN is also high, the normal noise is to +20 dB, so I use the attenuator for to get the noise lower, at a reasonable level as it have no sense seeing the S meter to S9 + 20 only because of the noise and so to loose a big part of available Rx dynamic range. The PIN mods are usefull here in Eu.
73,
Traian, YO9FZS
All the Best,
Traian

From: Traian Belinas [mailto:traian.belinas@deck.ro]
Sent: Wednesday, 22 June 2005 10:26 p.m.
To: jaking@es.co.nz
Subject: Re: pin diode, reversed FET

Jeff King wrote:
Traian,
Hi thanks for this. It did really help my understanding.
In New Zealand we have max of 4,500 hams.
The bands are not crowded
http://kb9amg.slyip.com/markd/KB9AMG/top_dx_spots/by_callsign/zl.html
This is the strongest ZL stations.
So on 80 meters at night I can tune whole band and only hear about 2 or more other stations.
My 80 antenna, you have seen diagram is only about 13.5 off ground so it does not work well.
Usually I hear Australian stations and occasionally some USA.
Yes when propagation is there I hear those strong Russians here too.
Now back to Pin diodes.
My simple understanding of how the pin diode works is that the clean pin diode prevents other unwanted multiple frequencies up and down the band. This would seem to be an advantage during transmitting because it prevents unwanted additional off frequency splatter signals on the band.

Until I read your email yesterday, I did not comprehend to the fact that of course this works in reverse for receive!!! It the existing diodes generate those off frequency signals then of course the a nearby signal will be picked up off frequency in reverse the same way and that off frequency signal will be heard as interference on top the signal you want to hear. Hence Pin Diodes significantly improve the selectivity of the receiver. Traian please confirm this understanding is correct.

Not quite so.
The PINs will have big advantage for Rx only.

The problem with the normal junction diodes is that when they conduct (when the filter is switched in line), the far out of band signals may cause 2nd order IMD and the close or in band signals may cause 3rd order IMD. Note that the in band mean inside the BPF which may have many MHz bandwidth...
Actually the diode act like a mixer (such simple one diode mixers are used, especially at SHF)! You may see how it hapen if consider the unwanted signals which will be mixed by the diode...
For example, when receiving the 14 MHz band here in EU, if big signals exist in the 41m broadcast band, they may cause second order IMD (a 7110 and 7150 kHz BC stations may produce a ghost signal at 14250 kHz as second order IMD; the same will hapen for different bands/frequencies...). Also, when receiving the 40 m ham band, two signals on the 41m BC band may cause 3rd order IMD apearing as ghost unreadable or carrier signals on the 40m amateur band. These are only particular examples, as when the propagation is good, many hundreds of signals arrive simultaneously at the RX diode bandpass filters input which may cause a lot of trouble, especially the stronger ones, the band may seem noisy or ghost or unreadable signals may appear.
The advantage of the PINs is that they act (theoretically) as controlled resistor, they can rectify and mix only for the signals at frequency lower than the one corresponding to its carrier lifetime and their switching characteristics regarding the produced IMD are much better than for the normal diodes.
You may understand now why PINs having large carrier lifetime specification as the BA479 are better for HF than the ones having very small carrier lifetime: they may maintain the same good IMD behaviour at lower frequencies; and the bigest problem is at the lower bands, as Thomas measurements confirm, it is just a practical confirmation of the theory...
Regarding the TX, the signals switched during Tx are few, they are the mixing products from the Tx mixer and IMD is not a problem, as all are originating from the same signal, so a PIN will not make large improvement for Tx. Actually, the Tx IMD are generated by the final amplifier...
Jeff, please note that the proffesional Rx, if not using relays for the BPF switching then they are using good PIN diodes.
So, using PINs instead of the existing diodes is a good thing, especially if the above mentioned problems seemed to occur (so include the presence of the strong signals of the broadcast bands!).
But if big signals are not present, if have a good quiet location like yours, and when considering the cost and the effort involved, it may not worth doing it. It is only a decision of each of us, depending also on the local Rx conditions...
This is what I intended to let you know before.
The mod shall be more usefull for me here, but I am not decided because I will have to sell all the radios some day, so no reason for spending $ and effort for such mod, and I consider also that some buyers don't like buying the modified radios...

Now I must admit I am not sure if I Need these pin diodes. Now propagation is not good I am only really listening on 20 at about 3 UTC. According to Thomas [if one want to avoid losses] I probably should only be interested in changing the diodes below 10 MHz, so this is really only going to improve 40m and 80m
Yes, this is done on some Rx, as the Icom R9000, where the Rx BPF are splitted in two banks (LF+MH and HF) switched by good PINs.
the other diodes are normal.
[The TS950 SDX Rx BPFs are also separated in two banks by a HPF filter which attenuate the LF/MF signals when using the higher bands, for avoiding the 2nd order IMD caused by the LF/MF broadcast signals. This is the only difference between the TS950SD and TS950SDX regarding the RF board/front end , and some amateurs that are not aware of this are still speaking of the "big difference" between the two radios !!!]

Now I'm convinced not to do the PIN diode mod. I think you are right I do not need it here, where there is little interference.
==========
I look forward to your reply.
Yours sincerely

Jeff King

PLL BOARD PROBLEMS

PLL BOARD 0: Reseat Connectors

[Kenwood] 940S Question -Solved
RMead100@aol.com mailto:RMead100@aol.com
Fri, 7 Jun 2002 12:24:47 EDT

At the suggestion of one of the list members, I lugged the xcvr off its self and removed the cases and reseated all of the connectors on the boards which
I had moved. PLL and one underneath. Also, I reseated the connectors on theDigital A board above the PLL.

The "missing bands" are now working fine.

I think the connectors on the Digital A board are vulnerable to improper seating, and being properly pulled loose, ESPECIALLY when that board is
lifted and tilted aside to get to the PLL board. There is one very long connector on the front left of that board which seem to work itself loose at
one side and needs to be looked at.
Thanks to all
Randy K8BUX

PLL BOARD 1: Remove the Black Foam from Behind the Board

From: "kt4xw" <kt4xw@...>
Date: Sun Jul 25, 2004 9:41 am
Subject: Re: TS-940 Very low output. update kt4xw

Hello,
This morning I had a chance to look at the rig again, and found out some things that were interesting. The power adjust control on the
front panel, along with the carrier control in cw all seem to work. The output power goes up and down with adjustment. With the power out
adjustment VR2 all the way up, the SSB power jumped to 100w, but I still only had 3w or so CW. The IC meter showed 4 amps with no output
on SSB, so I check the current with a ohm meter and verified it was around 1.2a. A adjustment of the IC0 control fixed that. With 100w

out on SSB, the IC meter read over 16a. The ohm meter read 8.5a to 9a Adjument of the IC meter adjust pot fixed that. Then, on a fishing
expedition, I look at the micro processor board, and fixed several fish eyed solder joints, no help, but made me feel better. Then,
under the Het. Osc. on the PLL unit there was a piece of black conductive foam that had deteriorated. Also, it had a green/white
residue covering it. I cleaned all of it, and removed the rest of the foam. It helped alot. I had to readjust VR2 back down to 110w or so,
and the CW output jumped up to 15-18w. But still, that is it on CW.

Thanks for all of your help!
Keith Spainhour, KT4XW

PLL BOARD 2: Remove the Wax from the VCOs

From: Garey Barrell <k4oah@...>
Date: Thu Oct 9, 2003 1:49 pm
Subject: Re: [ts-940] Welcome k4oah

Fred -
This is an indication that one or more of the PLL's are unlocked. It will only get worse!
The two VCO's under the speaker (two layers down, of course!) are "potted" with a sort of beeswax. Over time this wax becomes contaminated and the VCO's become unreliable.

I fixed mine by using a heat gun (judiciously) to melt the wax out of these two compartments. Standing the transceiver on end, tipping it toward me and putting a piece of cardboard under the shield can to catch the wax as it drips out. Some will run out 'under' the shield, but it can be picked off with a Q-tip stick or other.

The alignment was not changed in either circuit, but it wouldn't hurt to check the adjustments in those two areas after the "meltdown". They are simple peaking adjustments.

Solder troubles are more common in the TS-440 and TS-930, but could be a problem in the 940 as well. My AVR board had a LOT of solder problems, but I have not reworked VCO areas.

73, Garey - K4OAH
Atlanta

PLL BOARD 3: Identify which PLL is not locked

From: "k8aicurt" <k8ai@...>
Date: Tue Nov 30, 2004 1:57 pm
Subject: Re: PLL unlock k8aicurt

Well, I finally got it working. There is a line on the PLL board that goes to the control unit that's labeled "UL". This line goes low if one of the individual PLL IC's is in unlock from both the PLL board and the carrier board. If you have dots on the display, first disconnect connector #2 on the PLL board and check the voltage at connector #5 pin 5. If the voltage is "high" (~4.6V) then the unlock is on the carrier board. If the voltage is still low (~0V) then replace the #2 connector and then check the voltage on the individual IC's.

Check the voltage on IC8 pin 2, IC9 pin 2, IC19 pin 2 and IC17 pin 7. The one(s) that has(have) a low voltage on them are the PLL's
out-of-lock. Troubleshoot that PLL circuit.
Curt, K8AI

PLL Board 4: PLL Board and RF Board and PLL out of lock

kc0bi <kc0bi@yahoo.com> wrote:
Hello everyone. I am troubleshooting a TS-940S and it has at least two problems - I tackled the easy one first
- it had a bad optical encoder and I replaced it with a known good pull from a TS-430S.

This unit definitely has PLL problems - the exact frequency that it fails changes with heat but the general problem is this: Above 10 MHz it works correctly in USB and LSB - below 10 MHz it works only in USB. There is an area between approximately 9 MHz and 10 MHz where it is probably unlocked but the frequency display still works - and that point changes with heat. Below 9 MHz it gives the "all-dots" display indicating PLL unlock (but seems to still work in USB). I am using the built-in 100 kHz calibrator as a signal. After a period of time the nice sounding sine wave becomes a very "ratty" sounding tone. This is true regardless of which sideband and at any frequency I've tried. Does anyone have an idea of where to start looking? One of the PLL's must be losing lock. Thanks in advance and 73,
Harold W0HJW (formerly KC0BI)

From: [mailto:TS930S@yahoogroups.com] **On Behalf Of** Bill K0ZL
Sent: Wednesday, 19 October 2005 11:47 p.m.
To: TS930S@yahoogroups.com
Subject: Re: [TS930S] TS-940S Phase-Lock-Loop Problems?

Drop your RF unit down (rig up on it's left side) and resolder all around the VCO area, which is about the front 2-3" of the board. Also resolder around the RF RX preamp and first mixer area (that is on the same unit, the narrower shielded area, about mid-way back.

Be patient, you have about a two hour job there. Use bright light and drugstore reading glasses to make sure you get them all and watch for bridges as you solder. Much easier to find and clean them "as you go" rather than discover them later.

Next, get the PLL unit out, scrape the adhesive pad from under the VCO nearest the front right cornner of the board (as the rig is facing you), and Resolder that area about 1 sq inch.

Next, do the PLL/VCO service note [Editors Comment this is Service Bulletin 900], which should be in the files section of the group. Requires an RF probe for your DVM.

73, Bill K0ZL

CONTROL BOARD

VOLTAGE REGULATOR HEATS UP AND CAUSES A SHIFT IN BFO ON IF BOARD

-----Original Message-----
From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Monday, 2 May 2005 9:23 a.m.
To: jaking@es.co.nz
Subject: RE: ts-940

(4) One of the voltage regulators on the control board warms up the bottom of the 940, which causes a small but detectable shift of the BFO on the IF board. I removed this regulator from the control board and mounted it on the big aluminium heat sink at the rear side of the TRX.

Best 73s for today, Jeff
Thomas, DF5KF

>From: "Jeff King" <jaking@es.co.nz>
>Reply-To: <jaking@es.co.nz>
>To: "'thomas hohlfeld'" <thomas_hohlfeld@hotmail.com>
>Subject: RE: ts-940
>Date: Fri, 27 May 2005 19:35:16 +1200

Your mod (4) is also very helpful for me. I have heard about a TS-940 that is supposed to have this problem of frequency drift after operating for 30 minutes. It apparently shifts frequency slightly then jumps back. Just sometimes: comes and goes. Sounds like you have solved the problem. Wow thanks. Can you please tell me which regulator was it that you shifted to the heat sink?

>Your sincerely
>Jeff King

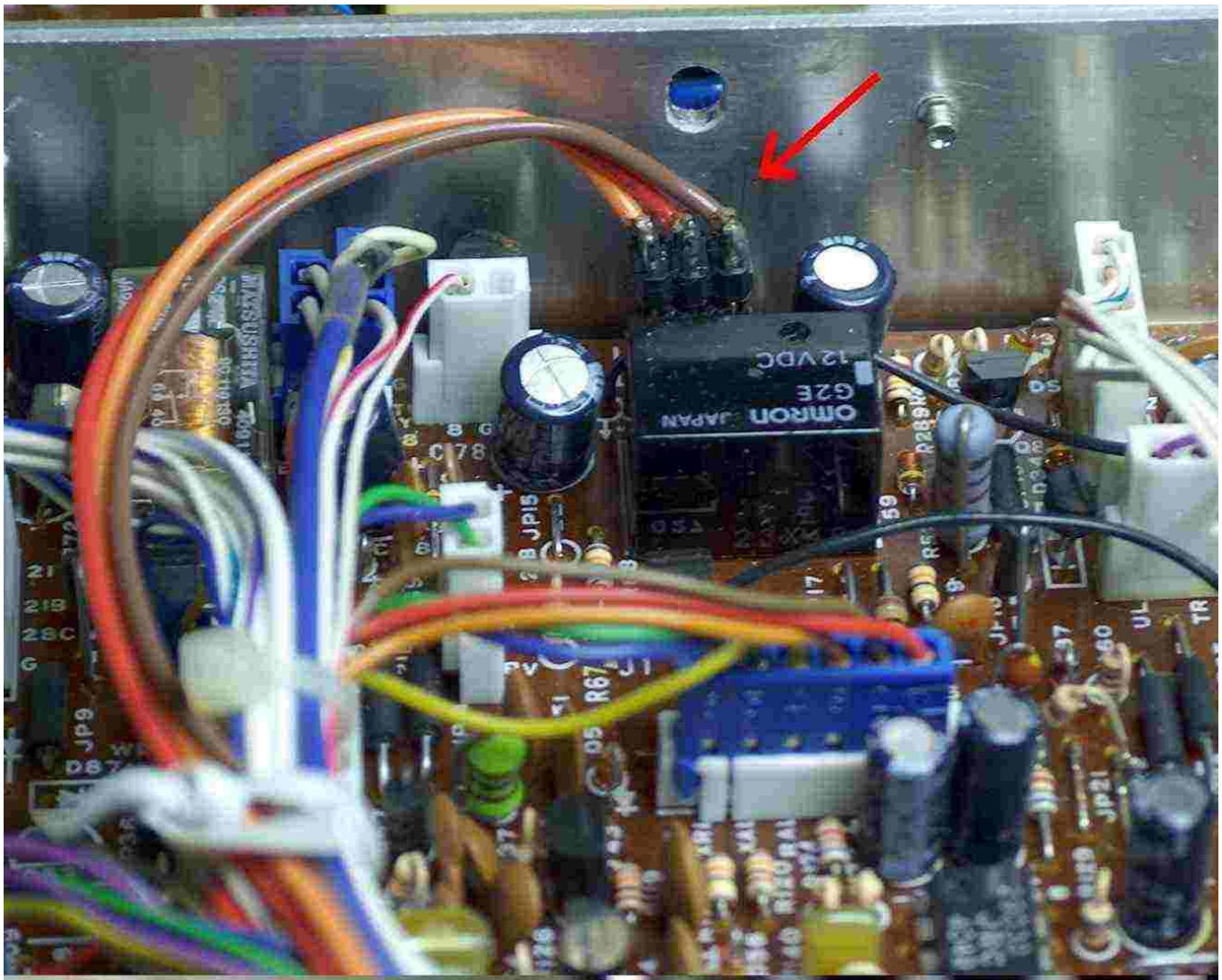
-----Original Message-----

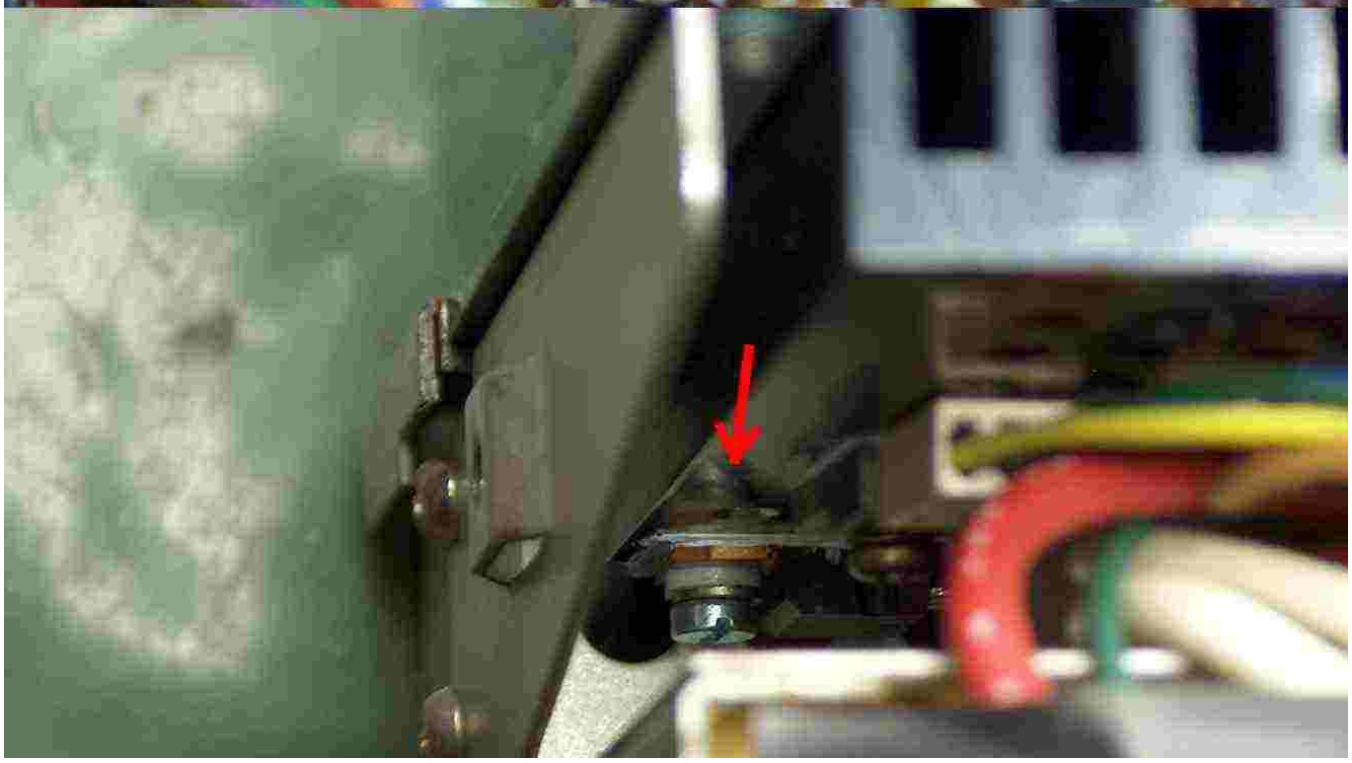
From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Tuesday, 31 May 2005 9:15 a.m.
To: jaking@es.co.nz
Subject: BA479 etc.

You also asked for the IC that warms up (my mod 4). I believe it was either IC7 or IC6 on the control board, but I am not entirely sure. Next time I open my 940 I will see and let you know. Warming up of the IC caused a slow shift of the 100 kHz BFO (L19). Indeed, L19 was quite sensitive to changes in temperature in my 940. Perhaps you should verify with a counter that the jumps in frequency you mention are really caused by this BFO.
Best regards for today and vy 73,
Thomas,
DF5KF

-----Original Message-----
From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Friday, 10 June 2005 8:56 a.m.
To: jaking@es.co.nz
Subject: RE: BA479 etc.

As my TS940 is open now, I had a look which of the voltage regulator IC I had moved back to the heat sink. It is IC7 on the control board, next to relay RL2. I include an additional jpg file which shows (upper figure) the place on the control board where I replaced IC7 by a connector with the three cables leaving (arrow). The lower figure shows the voltage regulator at its new place (arrow). The heat sink needed to be unscrewed in order to drill a hole for mounting IC7. I mounted IC7 isolated from ground. If you decide to do this mod, be very (!) careful not to make any mistakes. The primary 22V line may cause severe damage when connected to the 15V regulator output.


OMRON JAPAN
G2E
12 VDC
C78
JP15
R67
JP6
JP21



Good luck for today!
Thomas
DF5KF

See also COOL AVR COMPONENTS BY REMOUNTING ON HEAT SINK Below:

AVR BOARD & POWER SUPPLY

FAN AND TEMPERATURES

eHam.net Forum : Elmers : Kenwood TS 940s Forum

Kenwood TS 940s Reply
Anonymous post on February 19, 2001
Can someone help? My fan in back of my TS940s has developed annoying rattling sound, nothing appears to be loose. Is there any quick fix to this problem? Thank you

by AL7BB on February 19, 2001
This fan has sealed "permanently lubricated" bearings, if it is like the one on my TS-940.
With this type of motor, I have had some results in lubricating motors like this by taking a straight pin and pricking a small hole in the cover over the bearings, and injecting a light oil through the hole.
This will possibly extend the life for a short period, but in my experience, it is time for a new set of bearings, or in this case, a new fan motor.
Bill, AL7BB

by WG7X on February 21, 2001
My TS-940S and two of those owned by fellow hams have developed the noisy fan. Like another poster, I oiled my motor, and that helped for a little while. Eventually, the motor failed and had to be replaced.

You should also be aware that there are two of these fans. Number one, and usually the one that fails, is the one on the back of the transformer. Number two is the fan on the finals. This fan can be seen inside the rig. Look down through the slots on the top cabinet in the right hand side in front of the finals. This fan probably would be a bear to change. Thankfully, the ohter fan seems to fail more often. These fans go for about $32(US). I bought two just in case.

Sometimes I also use an auxillary fan over the transformer. Of course, this intorduces a little extra fan noise into the shack. I might eventually replace the back fan with a full time muffin fan on the back transformer. I tried that while waiting for the replacement fans to arrive. A six-inch fan does a great job of cooling the power supply. In fact, it does a BETTER job of cooling the rig. I know this because I used a Fluke DVM with a temp. probe to measure the temp of the cooling fins. With the stock fan, the thermistor kicks in at about 45 deg C. With the muffin fan I was able to keep the temp at about 20 deg C.
Gary WG7X

by AL7B on March 22, 2001
I replaced my fan about 8 years ago with one used for cooling a 486 computer chip. I was too cheap to pay Kenwood $35 for a new motor. After tweaking the brushes a few times I gave up.
I did have to pack foam around the opening to force the air through the fan, but it has worked fine over the years.
Something to think about anyway and hope this helps.
Dick
Anchorage, AK

COOL AVR COMPONENTS BY REMOUNTING ON HEAT SINK

From: Victor Zelenin <vic_kz@mail.ru>
To: jaking@es.co.nz
Date: Tue, 27 Sep 2005 17:09:12 +0400
Subject: TS940 Mods

Dear Jeff,
Thank You for the nice page about Kenwood TS940S.
I have a small question to Thomas DK5KF and to Jeff as experts.
I am waiting replay from both of you.

DK5KF wrote the mod N4 Voltage regulator heats up and causes a shift in BFO on IF Board".

In my TS940 there is the shift in BFO due the warm up. The shift is about 150 Hz per first 30 min of operation.
Thomas advice to be careful with the IC7 voltage regulator on the Control Unit.

From my assumption it is god to reduce the voltage drop on IC-s on the Control Unit via AVR Unit thru reduction the signal 21T from 23.2V (see service manual page 103) to 21 V.
May be the name of the signal has a sense? To drop the voltage we shall use D14 with 22 V or a bit less.

U (i/o) IC7 = 23.2-15=8.2 V
21-15= 6V
6:8.2 *100 =73%
So we would have a 27% reduction the dissipated power from all the 3 voltage regulators in Control Unit.

Additional advantage of my suggestion is: the Q6 will not blow when AC 220 Volt is low. It is happened in winter time in Russian country side due electrical heating of houses.

When AC =190V, the voltage drop on Q103 too low, it current amplification is low (beta is function from emitter-collector voltage), due that Q6 is trying to give more drive to Q103 till Q6 had burn with D14. I have changed two times Q6 with D14 by the conditions.

Best regards Jeff and Thomas
Victor UA2FP
Kalinigrad, 27 September 2005

-----Original Message-----
From: thomas hohlfeld [mailto:thomas_hohlfeld@hotmail.com]
Sent: Sunday, 16 October 2005 9:44 a.m.
To: vic_kz@mail.ru
Cc: jaking@es.co.nz
Subject: RE: Fw: TS940 Mods

Hi Victor, hi Jeff
sorry for the late reply. I had to visit a couple of conferences during the last days.

Victor's suggestion to reduce the 21T Voltage from 23 to 21 Volts, bringing down the heat production of IC7, makes perfect sense to me. Let us know whether this will help to reduce the BFO shift of your rig during warm-up.
It is interesting that the service manual says that D14 is either an MTZ 22 or an MTZ 24 type (legend below the AVR schematic, page 103). It seems therefore that Kenwood has also tried different diodes here. One of my 940 rigs is presently open, so I did a few measurements. The voltage across D14 is 22.7 V. At Pin 21T of the AVR unit I have 21.2 V. It appears thus that my TS-940 has the MTZ 22 diode.
It may be interesting to you that, despite the lower 21T voltage, I had to replace Q6 a couple of years ago. I chose a standard NPN type in a TO-220 case. This one gets only a bit more than handwarm and there were no problems any more.

In addition to Q6, other parts on the AVR board also become quite hot, for example C12 after a couple of hours. I found that diodes D10-D13 are the reason. They dissipate a lot of heat to the board (which turned dark below the diodes) and to other parts, such as C12. I removed these diodes from the AVR board, connected an appropriate bridge rectifier with sufficiently long wiring and mounted this rectifier on the black heat sink. D1 and D2 ran also hot and were moved to the heatsink as well. This has helped, C12 remains cool now.

Best regards and 73s for today,

Thomas
(DF5KF)

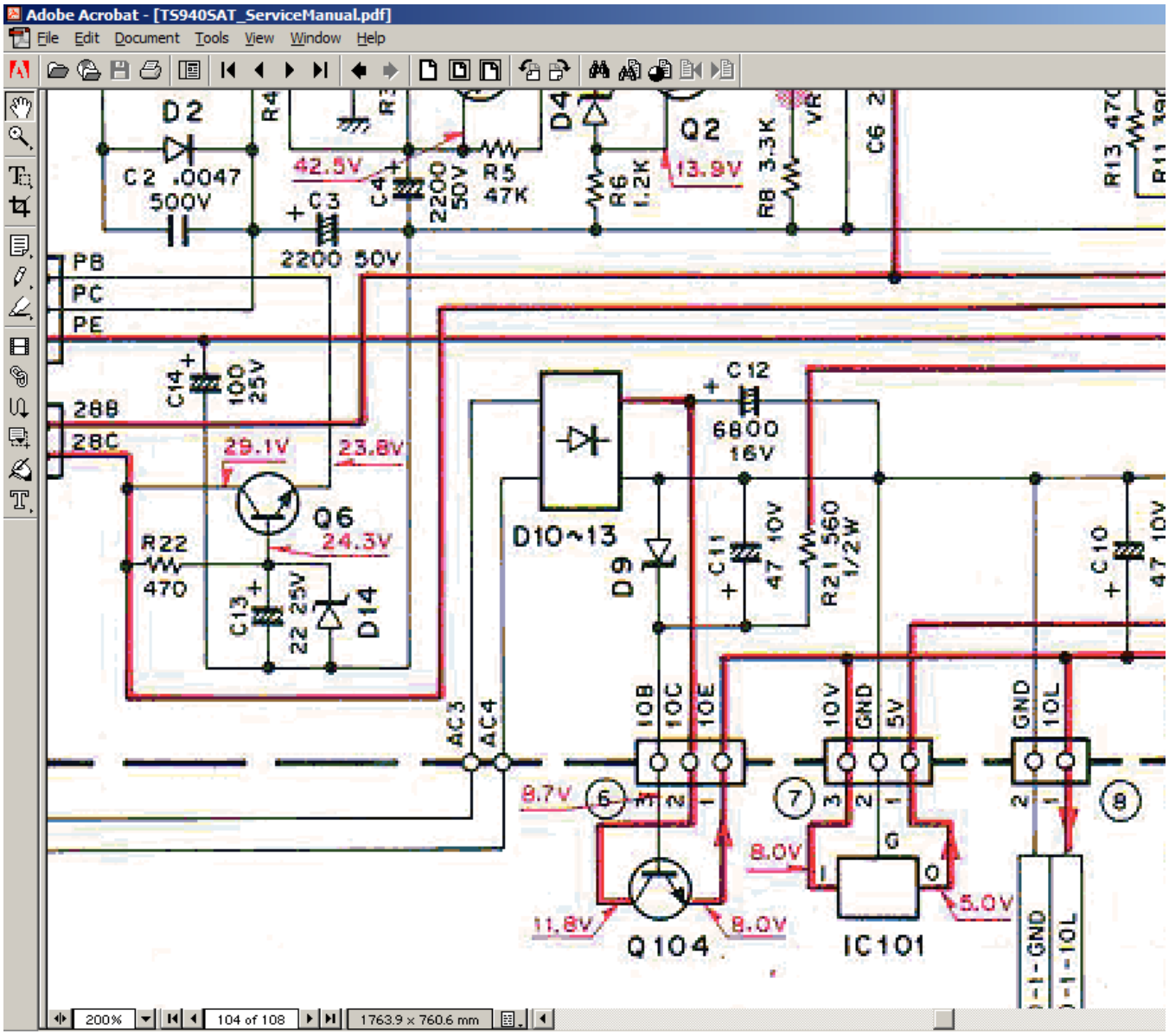
ZL4AI ran the TS-940 for two hours and turned it off.

	Has been replaced with	Measured operating at temperature degrees C	Rated operating temperature degrees C	
D1, D2	D4SC6M 60V 4A	76	-40 to + 150	
D10, D11, D12 and D13’	1N5408 [1000V 3A]	76	-65 to + 150	
C12		45 (on top)	+ 85	

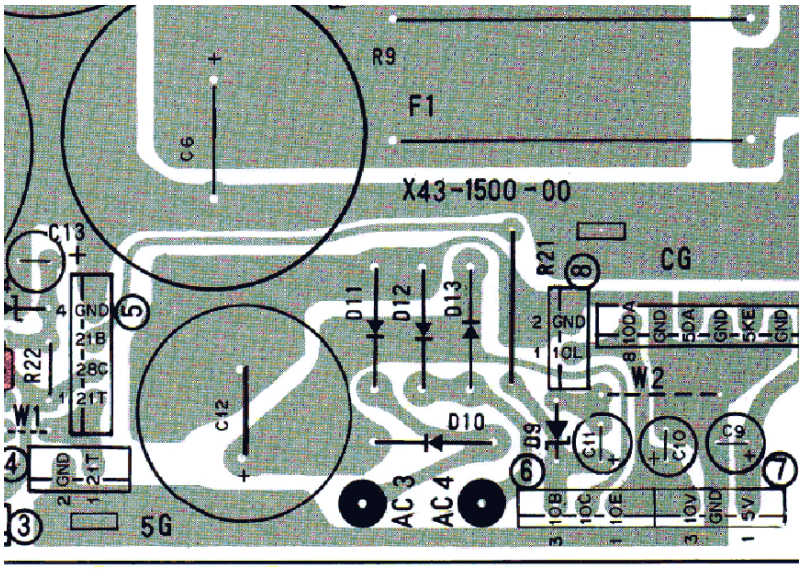
76 is far too hot to put your finger on. Something could be seriously wrong in the

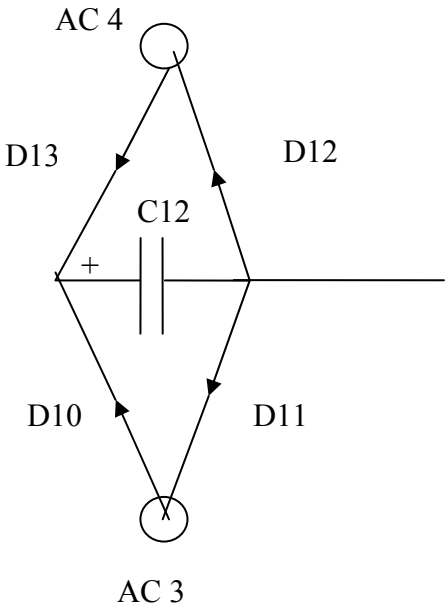
design which allows these components to run so hot.

So what do D10 to D13 do?



It is hard to tell with above AVR circuit diagram, so lest redraw the circuit below:





This diagram is still under construction. Intention when finished is to show bridge rectifier can be put in here

ZL4AI undertook more measurements and a modification:

	ZL4AI measured (original)	DF5KF measured (original) (above)	on circuit diagram	ZL4AI replaced D14 with 1N4748-209 1W
D14 marked	'22D'			'1N4748-209'
across D14	22.8v	22.7v	24.3v	22.8v
pin 3-21B on the Control unit	21.6v			
pin 5-21T on AVR	21.6v	21.2v	23.2v	20.7v
pin 5-21B on AVR	21.4v			20.5v

ZL4AI followed through circuits feed by line 21T.

All other lines appear except the DC-DC unit appear to end in voltage regulators or similar semiconductors which put out even lower voltage at a level controlled by the semiconductor, rather than the initial 21v feed value.

The exception is the DC_DC unit which feeds through a transformer to supply the high voltage feed of [-44.4v] display,
The -44.4 v is the only voltage that is directly reduced by lowering the voltage on 21T. It does not appear wise to lower the display voltage. (If anything a higher voltage maybe better, (hence the higher (original) values on the circuit diagram)

Also as rule of thumb, voltage regulators should be feed by 2.5 volts higher than their regulated output. IC8 on control unit has an output of 17.9 v so lowest feed voltage should not be below (=2.5v) and that is 20.4 volts.

ZL4AI believes the best approach is as taken by DF5KF: Put in better cooling at each overly hot component.

Power Supply HEAT SINK RUNS TOO HOT

quickfaststang <scott.vitiello@verizon.net> wrote:
I just bought a ts-940 off of ebay. Had it on for about 3 hours just receiving and i noticed the unit was getting pretty hot,
i also noticed the fan or fan's are not working, Now i believe they are tempature controlled,
So my question's are: Do these radio's normally get real hot, before
the fan kicks on ? Also, I am sure this is a common problem, So What
usually is the cause of this, Is it the motor probabally burned out
or the thermistor etc. ?
Also, I believe there are 2 fans one in the tranformer area and one
in the final section, I dont believe any of them are working, but my
main concern would be the tranformer fan first !

From: Bill <coorsbill@y...>
Date: Thu Jun 12, 2003 11:05 am
Subject: Re: [TS930S] TS-940S Fan Low-temp Mod

All 930s and 940s, were designed for the fan to come on almost too late... in the interest of "quiet operation" (that is, until the 29v pass transistors go into thermal runaway, destroying your drivers and the AVR unit in the space of about 30 milliseconds. It's quite spectacular, and I would not recommend missing it if it happens).

Alas, to prevent this from happening (and missing out on the fireworks), there are two paths you can take:

One, provide a circulating fan near the rig or behind it, to remove the heat from the heat sink.

Two, modify the circuit that controls the PS fan (there are only two fans, the PS and the PA or final unit, with separate control ckts) to turn the fan on sooner.

To do the latter, unplug the rig for about a half hour to allow all the big caps to discharge. Carefully loosen the AVR unit (power supply regulator board) to access the solder side. Change R11 from 390 ohms to 470 ohms. Can be 1/8w or 1/4w. This will cause the power supply fan to come on at a lower heat sink temp.

You can test the fan by unplugging it from connector 11 on the AVR unit, and then insert the leads of a 1K or so 1/4 watt resistor into the connector holes. Then jumper 12v across the resistor, positive to the center of the fan coax connection. The fan might be a little noisy... that's ok cuz it never runs at full 12v. bill

ZL4AI changed R11 to 470 ohms. Afterwards with temperature probe in the hole in the heat-sink beside thermistor 101, and the case off the fans starts at 48-50 degrees C and stops at 27 degrees C. Case on above the heat sink beside thermistor 101 fan starts at 41 degrees C and stops at about 27 degrees C. This is a very safe modification and highly recommended.
[You might at worst wear our the fan motor at a cost of $30 replacement compared with >$200 of transistors and many hors of repair time if Q101 or Q102 over heat.]

VERIFY THERMISTOR 101 IS ATTACHED AND FUNCTIONING

ZL4AI 940 had a very hot TS-940 power supply.
On removing the power supply heat sink the thermistor 101 actually fell out of its housing metal housing. It had become unglued. It had been sitting in the correct position but probably was not making adequate contact thermal heat transfer. Hence not turning on the cooling fan.
To verify the thermistor changed resistance I connected a ohm meter and heated the thermistor with soldering iron. It went from approx 16,700 ohms at 12 degrees C to 220 ohms at say 400 degrees C. I have no idea if these are correct resistance values but they give an indication of what happened.
If anyone has the temperature table for Thermistor 101, please send to jaking@es.co.nz.

On page 8 of the promotional brochure above, its shows that the heat sink should run at or below 40 degrees Celsius.

REPLACE Q101 AND Q 102

ZL4AI found after replacing the original power supply transistors 2n5885 (60 volt version) with the 2n5886 (80 volt version), the heat sink temperature seemed to decrease.

MOTOR BEARINGS GUMMED UP: TEMPORARY FIX

-----Original Message-----
From: kenwood-bounces@mailman.qth.net [mailto:kenwood-bounces@mailman.qth.net] On Behalf Of Garey Barrell
Sent: Friday, 28 October 2005 4:48 a.m.
To: Bill Stewart
Cc: kenwood@mailman.qth.net
Subject: Re: [Kenwood] TS-940S Cooling Fan Problem

Bill Stewart wrote:

>I have a TS-940S, s/n 6040XXX, which has a sluggish cooling fan (on left, facing front, behind the power trans.). Sometimes it will not start. I have shot WD-40 in it and tried to get oil to go down the shaft but sometimes it still won't start and if it does start, it turns slowly & erratically. I measured the voltage to be around 18VDC with the fan disconnected and connected, a fluctuating .5 to 1.5VDC with the erratic rotation.
>Questions: 1. Is this no-load to load voltage drop normal?
> 2. Does the voltage and fan speed increase with temp. rise?
> 3. If the above is a problem, are there any mods. to replace this fan or maybe make the fan run all the time?
>The fan runs ok if it gets beyond the low start-up point (on a seperate DC supply).
>Any comments will be appreciated, thanks...Bill K4JYS

Bill -

The problem is that the motor is drawing too much current at start-up. The supply voltage is applied through a series resistor and the excess current drawn because of the gummed up bearings is high enough to drop the supply voltage too low to start. The correct fix is to replace the motor. East Coast Parts has them but they are expensive, ~$30. You might be able to find a hobby motor that will fit, if you look long enough.

A "temporary" fix is to put an 18V Zener diode across the motor dropping resistor so that if the voltage

drop across the resistor is more than 18V, the Zener conducts, supplying enough voltage to start the motor. Once the motor starts, the voltage across the resistor drops below 18V and the Zener is out of the circuit. BUT this is only a temporary fix! If the motor freezes up, the 940 WILL overheat significantly.

73, Garey K4OAH
Chicago

-----Original Message-----
From: kenwood-bounces@mailman.qth.net [mailto:kenwood-bounces@mailman.qth.net] On Behalf Of Garey Barrell
Sent: Monday, 31 October 2005 4:10 a.m.
To: Bill Stewart
Cc: Kenwood@mailman.qth.net
Subject: Re: [Kenwood] TS-940S Cooling Fan Problem

Walt -

I have been through this several times. The problem is gummy or worn bearings in the fan motor. The "locked rotor" current is too high, dropping the supply voltage (supplied through an 18k, 1W resistor) too low to start the motor. The fan will start sometimes if you spin the blade to get it started. The fan will start and run fine if the supply is stiff enough. All Bill has to do is measure the voltage across the 18k resistor and he will see about 22V. The transistor will be saturated, and about a volt across the motor winding. An 18V Zener across the resistor will allow the motor to start, and once it starts the voltage across the resistor will drop to about 12V, and about 9-10V across the motor. But once the motor stops altogether, which it will, the transceiver WILL overheat, damaging AVR board parts first, and if you're unlucky, the PS pass transistor will short putting 40V across the final and driver transistors. The fan motor will sound cheap then...

73, Garey - K4OAH
Chicago

RF BOARD 1: Board Runs very Hot

[Kenwood] ts940s - PCB burning
Clif mailto:clif@avvid.com
Tue, 4 Mar 2003 20:06:53 -0600

That is the way they run, very hot. Reflow the solder on them with good solder and don't worry about it.

Clif Holland, KA5IPF
AVVid
Authorized Kenwood and Icom Service
www.avvid.com

----- Original Message -----
From: "PY2NFE" <py2nfe@uol.com.br>
To: "Kenwood" <kenwood@mailman.qth.net>
Sent: Tuesday, March 04, 2003 7:52 PM
Subject: [Kenwood] ts940s - PCB burning

Hi Gang:
I need a help A TS940S is with a part from the printed plate of circuit - RF unit - blackened, but barely in the region of the transistors Q6, Q7 and Q8
(armored rectangular area). Already verify everybody the tensions and RF levels and is everything OK, but the transistors are heating more than the
normal one, causing problems in the solder. Soon after it link the radio the transistors (and all the region in return) already are with temperature
above of the normal one Someone has some idea?

73
Ronaldo Brisolla - PY2NFE
py2nfe@uol.com.br

HOW IT WORKS

AM MODE: HOW TO VERIFY ITS SWITCHED IN

From: Traian Belinas [mailto:traian@deck.ro]

the CAR acts for AM and CW only.

For the AM and CW, the balanced modulator is unbalanced also by CAR pot voltage by D89. for the AM and CW it is adjusted by CAR pot, it is not a fixed value voltage.
D97 is an OR gate which supply the unbalancing voltage for CW or AM modes only (the CAR acts for these modes only), switched by the mode voltages at the Q410 and Q408 outs, so by F and D CWG and AMG bias voltages respectively (connector 12, contact 6 and 4). So you may check for the AMG voltage and switching Q408.
When AM mode, Q408 shall supply the TV voltage (from connector 13) to the right side diode of the D97 then to the CAR potentiometer (CV1, CV2 at connector 14), then by D89 to the balanced modulator and so unbalancing it and so introducing the AM carrier for the TX path.
So, check if the Q408 output is switching from near zero to near TV value when changing modes from SSB to Am and follow that voltage trough that path down to the balanced modulator.

D78 and D79 have to be directly biased, i.e. current shall flow through them when AM. This mean they shall have 0,65 aprox voltage drop, anode to cathode. The current shall flow from the +15V line by the R277/R278 voltage divider to R276 - D78 - D79 - R300 chain to GND.

You shall check the voltage at the R277/R278, and all of the R276 D78 D79 R300 parts and the respective trace.

FM MODE: SETTING FM CARRIER

From: Traian Belinas [mailto:traian@deck.ro]

Regarding the FM power, did you tried adjusting the VR9 on the IF board, and checking the bias to the balanced modulator D73?
VR9 settle the FM carrier (ie FM output power), as it is adjusting the DC bias/unbalance to the D73 balanced diode ring modulator for FM.

Some of the TS940 VRs are very very touchy.
The power setting VR on the Control board and VR9 FM car are some of these. I am sure you have observed that others have this behaviour.

I have found the 940 as being the most "unstable" radio from all of I had, as the adjustments are very touchy and also need readjustment sometime or from time to time if you want constant trx parameters .

CW FILTERS

--- In ts-940@yahoogroups.com, "Stjepan Nikolic" <snikolic@...> wrote:

Hi all,
Just a quick question. Which CW filter would you recommend:
YK-88C-1 or YG-455C-1.
The price is very similar but I'm not sure about Performances on 40mtrs band where the noise is stronger than, for example, on 15mtrs band.
Thanks
73's Stjepan VK3TSN

From: ts-940@yahoogroups.com [mailto:ts-940@yahoogroups.com] On Behalf Of John Rotondi
Sent: Friday, 17 March 2006 10:07 p.m.
To: ts-940@yahoogroups.com
Subject: [ts-940] Re: YK-88C-1 or YG-455C-1

Hello Stjepan,

First, please note that the performance of these filters will not be evidenced by different performance on different bands, since these are 'I.F.' (Intermediate Frequency) Crystal Filters. I.F. Stages are used to provide fixed selectivity across wide frequency ranges while rejecting image frequencies. These are selectivity filters- not 'noise filters'- they will not lessen noise within their passband- but by having a reduced passband (over the SSB 2.4KHz passband let's say), they will pass less noise then the wider passband, so the signal-to-noise ratio within the passband will be greater. Please read the ARRL Handbook sections on Receivers for more information about I.F. stages.

The TS-940 has 4 Intermediate Frequency stages, with the capability of inserting filters into both the 8.83MHz, and the 455Khz I.F. Both the filters you ask about provide the same 500Hz bandpass characteristic, and should provide similar results when compared against each other. The YK-88C-1 is used in the 8.83MHz I.F., and the YG-455C-1 in the 455KHz I.F. You can use either one, or both at once to provide a cascade effect in terms of narrowing the response in the upper I.F. prior to the secondary filter, making the rejection of out-of-passband signals even more pronounced- especially helpful if they are strong
signals. You gain selectivity, and rejection of out-of-passband signals. The in-band noise should not be affected (lessened) by having 2 filters in cascade.

Note there is also a YG-455CN-1 250Hz narrow CW filter available for the TS-940, although this may be at greater expense. If noise is the problem, the narrower filter will have a better signal-to-noise ratio by 3dB over the 500Hz filter, assuming the same insertion loss.

I am using the YG-455C-1 by itself with excellent results, especially when used in conjunction with the CW VBT control and Notch Filter (this helps to notch out noise as well as nearby signals)- but I am not heavily working CW, nor do I have excessive noise. If you are heavily into CW, and especially CW contesting, then using both filters, or, better yet, using the YG-455CN-1 250Hz Narrow CW Filter in the 455KHz I.F. would likely provide the
optimum performance.

If noise is your main issue, it might be worth it for you to start with the narrow YG-455CN-1 CW filter- that might be all you'll need. If not, you can always add a second filter in the 8.83MHz I.F.

BTW, use of the RF Attenuator, or backing off on the RF gain control, and using the AGC in 'Fast' mode while in CW, will help lessen noise, if that is the main issue.

The TS-940 is a great radio! Have fun!

I hope this information is helpful.

73 es gd dx

John, WA2OOB

Service Manual & Serial Numbers

Clif Clif" <clif@avvid.com
Fri, 12 Jul 2002 14:03:51 -0500

Which revision???
Original Manual, Copyright 1985-2
Revised Manual, Copyright 1985-2/1985-9/1986-2
Revised Manual, Copyright 1985-2/85-9/87-3/87-4/87-10/88-4/88-11/89-08/90-3

That is from 3 different manuals, looks like a sackful of revisions are out there.
Clif Holland, KA5IPF

----- Original Message -----
From: "Brian P. Mileshosky" <n5zgt@swcp.com>
To: <kenwood@mailman.qth.net>
Sent: Friday, July 12, 2002 1:11 PM
Subject: [Kenwood] TS-940S Service Manual & Serial Numbers

> Hello Everyone,
> I have a gentleman who has an original "Revised Edition" Kenwood TS-940S service manual. However, I do not know what serial numbers it is good for. My TS-940S serial number is 6030606. Can anyone please comment on if the revised edition is the correct manual to have, given my serial number?
>
> Thanks and 73,
> Brian, N5ZGT

SERVICE MANUALS:
These can be found from time to time on the internet. If you need a service manual, we offer it on a comprehensive CD-ROM, which contains in PDF format, a complete set of TS-940 documents.

- 13 Service Bulletins (above)
-TS-940S Revised Service Manual, 62 pages,
-SO1 service adjustment instructions,
-SP-940 Service Manual,
-VS1 (Voice Synthesiser Unit) Service Manual,

-TS-940S operators manual, 108 pages
-TS-940S Technical Supplement, 48 pages,
- TS-940S promotional brochure 9in full colour),
- IF10B Instruction Manual [internal kit for computer interface control]
- IF232 Instruction Manual [external control unit for computer interface control]
-PC1A Phone Patch Operator Manual and wiring Diagram,
-YK-88CN manual,
-SWR 2000 Service Manual,
-HS5 Operators manual [headphones]
- SM220 Service Manual, 29 pages [Station Monitor]
-TL 922 Service Manual [1,500 watt linear amplifier]
- TS570 Control Program, fully operational,
-MC-43 operators manual,
-MC-60 operators manual,
-MC-85 operators manual,
-MC-90 operators manual,
- Kenwood miscellaneous connectors schedule,
- All files on this website

If you require the CD cost is $US11.00 plus postage. Please jaking@es.co.nz to request delivery.

Identifying When Radio Manufactured

ZL4AI advice:

Manufactured from approx mid 1985 to 1990. ZL4AI does not know the exact dates, and would appreciate being emailed this information.

940s was reviewed by QST in Feb 1986, so production began before then.
The 950s came out and was reviewed by QST in Jan 1991. Production of the 940 probably stopped in late 1990.

A well talked about scheme for the 950sdx is below:
ZL4AI found this system did not work for his TS-940 which was manufactured in 1986 and began with 6

A good idea is to
Take covers off and look at the IC chips.
Use the date scheme code below [W9IXX email], to confirm when the parts were made.

[Kenwood] TS-950sdx serial number
Bill Martin k4sgf@k4sgf.net
Sun, 27 Jan 2002 20:22:07 -0500

Mine is 01100190 so guess that makes it November of 98 - right?
Bill K4SGF

----- Original Message -----
From: NR1DX
To: k.d.wilson@ntlworld.com ; KENWOOD
Sent: Sunday, January 27, 2002 3:01 PM
Subject: Re: [Kenwood] TS-950sdx serial number

Kenwood serial number decoder

XYYZZZZZ

X-2 = last digit of the year
YY = Production Month
ZZZZZ = sequence in production for that month

So Kenny yours would have been the 7th unit to be produced in April of 1998 (the 950SDX wasn't in production in 1988). I'm told that this applies to all Kenwood rdaios manufactured in at least the last 20 years maybe longer

I wonder what the last official serial number was for the 950SDX? Mine is a 00900014. Anybody out there with a newer one?

Dave
Nr1DX

At 07:02 PM 1/27/02 +0000, k.d.wilson wrote:
>Hi Gang,
>The serial number of my TS-950sdx is 00400007, can anyone please tell me
>what year this is?.
>73 de Kenny M1HAM / M5RIG

[Kenwood] Fwd: RE: Feedback from Kenwood.net re:serial numbers
Phil Florig W9IXX@arrl.net
Tue, 09 Mar 2004 17:40:59 -0500

Hi all,
I received the following e-mail reference my inquiry on serial numbers for some of my Kenwood units. This information seems to correlate with the information on the date codes of some of the components. As you know there are usually
Date codes on components. The common way is to give a 2digit year and 2digit week.
EX: 9340 is 1993 and the 40th week
8837 is 1988 and the 37th week
As shown below my TS850s ser#60200208 is mfg in 1994. This is right as the component date codes are 9340, 9409, 9350, 9410, and etc.
As shown below my TS940s ser#9100162 is mfg in 1988. This is right as the component date codes are

8817, 8825, 8837, and etc.
Bottom line is to check as many parts in the rig as you can to see the general date span. I know that some parts may be older stock and some may have been replaced but the majority of the date codes should be within a year. This will hold true for most medium to high production runs.
Hope this helps in some way. Tnx agn guys for all of your inputs on this reflector and thank you Kenwood for answering my e-mail request so fast.
We do appreciate it.

73 Phil W9IXX

>Dear Kenwood Customer:
>
>
>There is no sequence with our sertial numbers. TS-850S s/n 60200208 1994 TS-940S s/n 9100162 1988
>If you need further assistance, please e-mail us again.
>
>Sincerely,
>
>Kenwood Amateur Radio Customer Support
>
>
>-----Original Message-----
>From: Philip Florig [mailto:null@kenwood.net]
>Sent: Saturday, March 06, 2004 9:22 AM
>To: KCC-Amateur
>Subject: Feedback from Kenwood.net
>
>Philip Florig would like the following help:
>
>Hi,
>The question has come up as to the meaning of the serial numbers used.
>Can you explain the serial number system to me please. I have 2-TS830,1-TS850, & 1-TS940.
>Serial numbers are TS850 60200208 and TS940 is 9100162. Would like to know date of mfg and any other information.
>Thank you in advance.
>Regards,
>Phil Florig
>
>Contact Information:
>Email address: w9ixx@arrl.net
>Call Sign: W9IXX
>Phone: (828) 863-2048
>Address: 115 Horne Rd.
>City: Columbus
>State: NC
>Zip Code: 28722

BULBS

Ham To Ham #13 - October 1996
73's Ham To Ham column
c/o Dave Miller, NZ9E
7462 Lawler Avenue
Niles, IL 60714-3108

Lighten up

From George Vaughn WA4VWR comes this tip:

"I've found a local source for the bulbs that illuminate the Kenwood TS-940's sub-display. When one of them went bad in my TS-940S, I removed both and measured the voltage applied to and the current drawn by the single working bulb...12 volts at 75 milliamperes . A trip to the local Radio Shack (reg. trade mark) store resulted in my discovering standard RS replacement bulbs of the exact size and shape (RS Cat. #272-1092), but the RS bulbs draw 15mA less, or 60mA - and they lack the little green "bootie" that the original Kenwood bulbs have. The green "bootie" can be carefully removed from the old bulb, provided it hasn't been "cooked" into place too badly, and with the aid of a touch of clear silicone grease, can be installed on the RS replacement bulb quite easily.

The 15 milliamp difference in current (and light output) is about the same as if one were to put a 47 ohm, 1/2 watt "bulb-life-extender-resistor" in series with the Kenwood bulb, so to me it's perfectly acceptable. The biggest difference is in the price...$1.49 for two of the RS bulbs vs. $4.19 each ($8.38 total) plus $6.00 shipping, for the Kenwood relacements. That's $7.19 per bulb from Kenwood...75 cents per bulb from Radio Shack. Guess which ones I'm using in the future.

What about the TS-940S's 'S-meter' bulbs...does Radio Shack carry a replacement for them? Yes, but this time the difference is more pronounced. The bulbs in the S-meter are 12V at 75mA; the Radio Shack replacement with wire leads (Cat. #272-1141) is rated at 12V but this time at only 25mA. It's noticably dimmer than the stock Kenwood bulb, but it may be acceptable to many; you'd have to try it and see. Personally, I chose to use Radio Shack's Cat. # 272-1143, a 12V, 75mA bulb, but with a screw-in type of base. If you use the same bulb as I did, it's advisable that you not solder the 12 volt feed wire directly to the screw-type base, but rather wrap a couple of turns of non-stranded, fairly stiff wire around the screw-threads instead. Also be sure to connect the "ground" 12 volt feed wire to the screw-base, not the "hot" wire. If the screw-base on this bulb were to ever cut through the insulating grommet, you might damage your set if the hot 12 volt lead were connected to it and then shorted the supply bus to ground. You can easily determine which feed wire is "hot" and which is ground by measuring each with a voltmeter when the set is turned on. The "hot" wire will have 12 volts on it, and of course the ground wire won't. Again, make sure that the ground wire connects to the screw-base shell of the replacement bulb. The tip of the replacement bulb should be reasonably safe to solder the "hot" 12 volt lead to, using the existing "solder-blob" as a connection point...do it quickly.

One other small caveat, the #272-1143 bulb is just a tad too large to fit into the existing holes in the back of the TS-940S's meter, but a few seconds with a tapered reamer resulted in the right hole size for a nice fit...take your time and don't get carried away! If done properly, the original Kenwood bulbs can still be used later on if desired. By the way, it is necessary to remove the metal meter mounting bracket to perform this particular step, but again, the cost savings are well worth the small extra effort."

Moderator's note: We've all noticed how difficult it's become to change the pilot lamps inside of most of today's radios? In the old days - when radios and lamps both were a lot bigger - changing a pilot lamp was a pretty straight-foreword, easily accomplished job . The lamps were always mounted in sockets, and usually just a twist of the wrist popped it right out, ready to receive a new one. Not so today...most are now on small wires, soldered in-place and buried deep within the wiring of it's front panel. It usually requires some internal "surgery", so many hams either don't bother changing them at all when they burn out, or they leave the job for when the set has to be disassembled for some other troubleshooting reason. George has offered some well-thought-out advise in his tips from above; here's some more for you to consider.

What follows won't make the task of bulb changing any easier, but it just might double or triple the time between pilot lamp failures. When a lamp does burn out, many probably think first of going back to the manufacturer for a replacement. There's nothing wrong with that idea, especially if it's a very specialized type of bulb. But as George pointed out, it's probably the most expensive and time consuming route to take, especially when there may be a much more cost effective approach. Since Radio Shack stores stock a number of small low voltage lamps, many of which will either fit directly or can be adapted to fit, a bit of "ham innovation" is sometimes needed, as displayed in George's piece.

Take a look into what Radio Shack calls their 12V micro-lamp, Cat. #272-1092. It may well work as a replacement bulb for LCD displays and other situations where a very small size lamp is in order. Hobby stores also carry what they call "grain-of-wheat" lamps, which are very similar, but be sure to ask about their voltage and current ratings. By the way, using a lamp rated at a higher voltage is fine, as long as it will provide enough brightness once it's installed; in fact, it will last a lot longer than one rated at the nominal voltage. Additionally, if you lower the voltage to a 12V lamp, even by just a couple of volts, you'll increase it's life dramatically. I've seen test curves that prove that the life expectancy of a lamp zooms upward as the voltage across it goes down, and vice versa of course. Putting a resistor in series with each lamp that you replace, will often give you two to three times the life expectency from a given bulb, everything else being equal.

There are three things to consider before doing this: 1) what value resistor will be needed, 2) what its wattage rating should be and 3) how much loss of light is acceptable? Lowering the voltage to the lamp will decrease its brightness - and shift its color toward the red region - so you'll have to visually judge whether you can accept both of these consequences.

You can install the lamp, clip-leading a resistor in series with it, then looking at the meter or display under normal room lighting, to see if it's okay for you own particular situation. To arrive at the right resistor values, simply use Ohm's Law, plugging in the correct numbers for your own transceiver's lamp supply:
Voltage drop desired divided by the lamp's rated current equals the resistance needed.
and
Voltage drop desired times the lamp's rated current equals the resistor's wattage.
By way of an example, let's take the Radio Shack #272-1092 lamp that I mentioned before, which has a current rating of 60 mA or .06 Amp. Let's say we'd like to drop the 12 volts feeding the lamp down to 10 volts, or a 2 volt total drop. We plug in the numbers:
2 (volts) divided by .06 (amp) equals 33 ohms
and
2 (volts) times .06 (amp) equals .12 watt
Now we know that we'll need a 33 ohm, 1/4 to 1/2 watt resistor in series with each lamp in order to drop the 12 volt lamp supply down to 10 volts. A 1/2 watt resistor will provide a 4 times safety margin for heat dissipation (dissipation ratings for resistors generally assume their full lead length, in free air, so it's

safest to over-rate them by 2 to 4 times for shorter lead lengths and operation within confined enclosures).
By the way, try to avoid using bulbs intended for flashlight service...they're often high brightness, low life expectancy...since flashlights are usually on intermittently. There are charts available showing life expectancy at rated voltages for various lamp type numbers. The lamp's manufacturer can provide this information and it's also sometimes included in the more complete electronic supply house catalogs. It's surprising how much different lamps do vary in their average life expectations.
Dave, NZ9E

CONNECTOR PROBLEMS

The following is the most sensible write up I have ever read about connector problems It is from the site below which contains other information and is well worth reading.

http://www.qsl.net/n5iw/ts940.html

Next I detached and then re-attached each of the connectors mounted to the transceiver printed circuit boards. Systematically I went over each of the boards carefully; unplugging the connector, inspecting and then reconnecting each one. This process went routinely until I got to the main control board. On this board the fourth connector checked pulled completely out of the board (the male portion of the connector completely separated from the board) leaving two very clean holes in the board. I make a note of the faulty connector and continued checking plug connections. The very next plug checked also pulled out of the board. My inspection of the rest of the connectors did not yield any more problems quite so obvious.

I removed the board, inspecting the faulty connection points, and re-soldered the plug bodies back into the board. ….
Before removing the connectors I sketched a simple schematic and labeled it and the plug connectors. This enabled the return of the connectors into the original configuration without doing a lot of schematic wire tracing. I removed all remaining old solder from the original plug bodies and solder connections, then re-inserted the male plug bodies into the pcb board. I re-soldered these parts back into the boards and while the board was accessible to the solder iron; I used a jeweler's loupe and carefully inspected the solder points all over the board. I pay special attention to the plug body pins for the numerous connectors on the board. This process pays off big results! I find at least 8 other connectors on this same board that are obvious cold solder connections (the pins were obviously "floating" in the old solder, and moved visibly when touched). This discovery was very encouraging; an obvious root cause of some of the intermittent issues this rig has had in the past. I suspect that the loose plugs and many of the cold solder joints were actually caused by the WIGGLE and Plug/Unplug technique so heavily endorsed in earlier internet comments and reports. The first time it probably had good results; over time this technique actually increased the amount of transceiver issues.

I reheated the solder on the connector pads that are bad, discovering that the old solder would not stick to the plug body pins. I used a solder vacuum and solder wick to carefully remove the old solder from each of the old pins that I know and even suspect are bad. This process is repeated for any solder point that is suspect on the rest of the components on the board. As you can imagine; this process takes some time. When I completed the control board, it was re-installed into the rig, and the transistor heat sinks and disconnected plug bodies were re-installed.

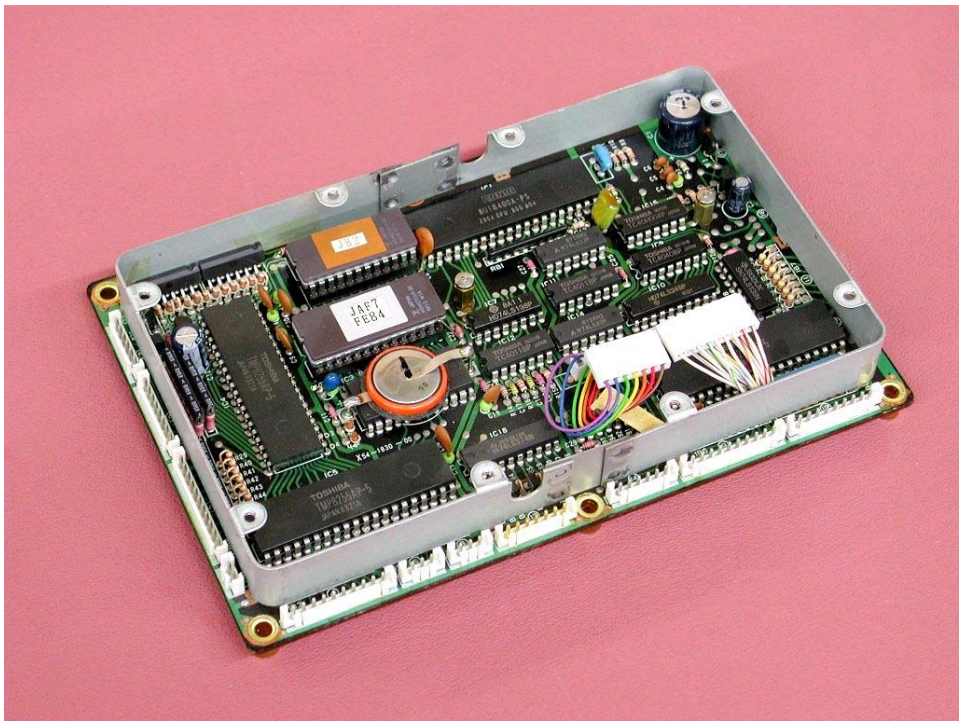
After completing the process noted above; I repeated the process for each of the other remaining boards on the rig. There are 5 other main pcb boards on the rig, not counting the little specialized boards located on the back of the main panel. I went through each pcb with the same process; finding and correcting more bad or suspect solder connections. In summary total; I corrected 2 completely disconnected plug bodies, 12-14 visually obvious cold-solder connections and another 30 or so suspected bad connections on various plugs and components.

BATTERIES: [INTERNAL]

There are two

1. Behind switch Unit L (X412-1600-00)

2. On Digital A Board: (X54-1830-00)



Typical symptoms for the Switch Unit battery failing are:

From: TS930S@yahoogroups.com [mailto:TS930S@yahoogroups.com] **On Behalf Of** Jim Bazsika
Sent: Tuesday, 21 March 2006 11:44 a.m.
To: TS930S@yahoogroups.com
Subject: [TS930S] 940 clock display stopped working

Good day all,
I recently got hold of a Kenwood 940. Fine audio on the radio (compared to the previous one I have - the 440), and very nice (although heavy) transmitter. I have only been using it a couple of weeks and the other day the green display that shows the clock and split freq's(which was working fine up until then) had some '0's in the display, as well as some '/' symbols when I turned it on. I shut it off and put it back on, and the display has been blank ever since.

Any ideas as to what the problem may be?? Could it be the clock battery? I don't know when, or if, the radio last had it's batteries changed, but I wouldn't think a clock battery would go so fast. I don't know. Any thoughts, ideas or suggestions would be very much appreciated. Thanks!
JIM
ZL4JB

BATTERY REPLACEMENT

From: Jeff King [mailto:jaking@es.co.nz]
Sent: Wednesday, 22 March 2006 5:16 a.m.
To: 'Jim Bazsika'
Subject: RE: [TS930S] 940 clock display stopped working
Jim,

Definitely the battery behind the LCD has lost voltage. Almost exactly same happened to my 940.

What I found was voltage on this battery had dropped to 1.7V, Should be 3V. found if I left the 940, 24 hours the battery recovered up to 1.8V and the sub display worked, for about 20 minutes, and then became scrambled letters again.

Anyway what to do to fix.
The TS-940 has internal batteries which are similar to a CR430. 3V lithium at 285 mAh.
Have a look at this page which explains battery replacement in an 850.
http://n6tr.jzap.com/850BAT.html

Genuine Kenwood batteries have metal tabs and leg pin wires on them and are soldered to the boards.

You don't need to use genuine batteries.

The table below shows many of the 3 volt dc coin type batteries you can use!!

Model Number	Capacity (mAh)	Dimensions (mm)					Weight (g)
		A	B	C	D	E	
CR 2016 RH	75	20.0	20.2	15.2	3.95	7.95	2.0
CR 2025 RH	148	20.0	20.2	15.2	4.85	8.85	2.8
CR 2032 RH	200	20.0	20.2	15.2	5.45	9.45	3.3
CR 2032 RH1	200	20.0	20.2	17.8	5.45	9.45	3.3
CR 2325 RH	190	23.0	23.2	17.8	4.85	8.85	3.3
CR 2430 RH	285	24.5	24.7	17.8	5.45	9.45	4.4
CR 2430 RH1	285	24.5	24.7	20.4	5.45	9.45	4.4
CR 2450 NRH	540	24.5	24.7	17.8	7.35	11.35	5.9
CR 2450 NRH1	540	24.5	24.7	20.4	7.35	11.35	5.9
CR 2477 NRH	950	24.5	24.7	17.8	10.05	14.08	8.4

You can buy a CR2430 at Dick Smith or Radcliff. If you want battery with legs which is easily soldered then go to Radcliff behind the Railway Station. It will take you a week to get. Maybe longer because they are unhelpful with finding small parts. But they definitely can obtain special batteries.

Any way I brought a CR2430 and soldered wires onto it. Wasn't easy to solder.

Then at Dick smith I brought two push on plugs, with legs that can be soldered directly into a board similar to those used in later model Kenwoods.
http://dse.resultspage.com/search.php?sessionid=44202d9e016908da273fc0a87f9906b7&site=&w=p2731

Cut one leg off the plug and solder it into the hole that was left when you unsoldered the old battery.

To get at the battery remove the top side screws on the front, loosen bottom screws and tip the front face forward. Then un plug, take out screws and remove Switch Unit L.

Unsolder the battery wires, and soldered in the new plugs.

Reassemble.

Find a small enclose to hold the battery, so if it leaks the enclose contains the leaking fluid.
Attach this container by Velcro to a convenient point inside the radio.

This way next time I replace a battery it will be just a plug in without having to take the 940 apart so much.

Next time I will look at using AAA size 3V lithium in a battery holder. With the potenetail long life from newer AAA lithium battery may never have to replace the again.

Yours sincerely
Jeff King
ZL4AI / DU7

INFORMATION NOT ANNOUNCED by KENWOOD:

While working on IF Boards the following parts were found to be missing:
Any information as to why Kenwood removed these parts would be appreciated. If box below empty means existence of component not yet searched for.

	First Edition Service Manual	Revised Edition Service Manual	Serial number 6,02x,xxx USA model	Serial number 6030687 USA model	Serial number 7,xxx,xxx USA model	Serial number 9,xxx,xxx USA model	Comment
IF BOARD C129	Exists	Removed	Removed	Removed	Exists	Removed	
IF BOARD R152	Exists	Exists	Removed	Removed	Exists	Removed	Reason removed unknown. Any information would be appreciated.
IF	Exists	Removed				Removed	

BOARD R118 as 4.7K between Q13 and L17 to C96							
IF BOARD C8	Exists	Exists	Removed	Exists	Removed	Removed	Reason removed unknown. Any information would be appreciated.
IF BOARD C9	Exists	Exists	Removed	Exists	Removed	Removed	Reason removed unknown. Any information would be appreciated.
IF BOARD C10	Exists	Exists	Removed	Exists	Removed	Removed	Reason removed unknown. Any information would be appreciated.
IF BOARD R220	Replaced with wire 105	Replaced with wire 105				Replaced with wire 105	Reason removed unknown. Any information would be appreciated.

KENWOOD RELEASED INFORMATION:

KENWOOD AMATEUR SERVICE BULLETINS
Available at: http://www.kenwood.net/indexKenwood.cfm?do=SupportFileCategory&FileCatID=1

ASB0896.jpg TS-940S LCD Clock Display Erratic Operation 81.38 KB
ASB0900.JPG TS-940S PLL Unlock 54.42 KB
ASB0907A.JPG TS-940S Antenna Tuner Relay Damage/Modification 69.35 KB
ASB0907B.JPG TS-940S Antenna Tuner Relay Damage/Modification 29.92 KB
ASB0908.JPG TS-940S PLL Unlock Due To Low Levels 91.39 KB
ASB0909.JPG TS-940S AVR Unit Capacitor Change/Failure 104.22 KB
ASB0910A.JPG TS-940S AGC Circuit Improvements 61.02 KB
ASB0910B.JPG TS-940S AGC Circuit Improvements 60.39 KB
ASB0912A.JPG TS-940S Transmitter Hum In SSB 71.53 KB
ASB0912B.JPG TS-940S Transmitter Hum In SSB 41.30 KB
ASB0913.JPG TS-940S Signal To Noise Ratio Improvement With NB 60.94 KB
ASB0917A.JPG TS-940S VCO/Carrier To Noise Ratio Improvements 89.43 KB
ASB0917B.JPG TS-940S VCO/Carrier To Noise Ratio Improvements 59.09 KB
ASB0917C.JPG TS-940S VCO/Carrier To Noise Ratio Improvements 36.90 KB
ASB0918A.JPG TS-940S Squelch Switching Noise S/N 711XXXX 85.04 KB
ASB0918.JPG TS-940S Squelch Switching Noise S/N 711XXXX 53.83 KB
ASB0918B.JPG TS-940S Squelch Switching Noise S/N 711XXXX 65.29 KB
ASB0921A.JPG TS-940S SSB Talk Power Improvements S/N 601XXX - 708XXX 84.05 KB

ASB0921B.JPG TS-940S SSB Talk Power Improvements S/N 601XXX - 708XXX 51.11 KB
ASB0951A.JPG TS-940S Erratic Display (Remove The ROM Socket) 84.33 KB
ASB0951B.JPG TS-940S Erratic Display (Remove The ROM Socket) 49.49 KB
ASB0988A.JPG TS-940S MFR-485 Driver Transistor Changes (Blue Dot) 79.27 KB
ASB0988B.JPG TS-940S MFR-485 Driver Transistor Changes (Blue Dot) 29.54 KB

ZL4AI found that some of the diagrams Kenwood put on the web cannot be read. Legible versions can be obtained by emailing Kenwood. It helps to point out there is considerable Health and Safety issue / liability fro Kenwood if an Amateur using information makes a mistake because the information Kenwood provided could not be correctly interpreted.

S METER ALIGNMENT LEVELS

Copied from “W6NL Mods for the TS-930.PDF”

Clif Holland of Avvid, a respected repairer of Kenwood radios, emailed me to note that the Japanese specification for the standard signal generator used in alignment is different from the US signal generator calibration. The 930 service manual refers to signal levels in dBuV, so I had assumed 0dBuV was 1 uV and 40dBuV was 100uV.

But not so. Clif is right and I'm off by 6 dB. I checked it out, and although I see no mention of the issue in the TS-930 or TS-950 manuals, I found a table in the TS-850 service manual, pg. 96, that confirms this. It has two columns:

Japanese "SG"	*American "SG"*
-6dB	*0.25uV*
0dB	*0.5uV*
6dB	*1uV... etc.*
40dB	*50uV... etc.*

Apparently the JA generator defines output in terms of open circuit voltage rather than voltage into a matched load. This 6 dB difference affects the alignment of the RF PIN attenuator start point as well as the S-meter settings for S1 and S9. Since the manual specs are ±4 dB anyway the difference will be mighty small except for a more active S-meter.

ZL4AI adds:
from page 78 / 79 of the TS-930 service manual, confirms the above:
Japanese SG 0dB = American 0.5uV

from page 51 of TS-940 Operating Manual
If a standard signal generator (SSG) is available, adjust VR-4 so the S meter indicates”S-9”, at 14.175MHz for a 40 dB (50uV) signal

from page 69 of the TS-930 service manual

SSG output: at 14.175MHz 100dB /u: = S meter reading S9+60dB +- 6dB

This 100 dB/u S-meter maximum calibration information seems to be unclearly laid out in the TS 940 service manual, but is inferred in the accompanying notes in the TS 940 service manual. It looks like Kenwood's made a typo and missed it out.

The TS-940 Service manual on pages 72-73 is not very easy to understand: ZL4AI have prepared the extended service instructions:

		Measurement			Adjustment		
Item	Condition	Test equipment	Unit	Terminal	Unit	Part	Method
6.1 S meter	BAND: 14.175MHz SSG output : 14.175 MHz 0dB/u	SSG AF V.M SP SCOPE			IF	VR3	Adjust meter nee for mechanical f
					RF	VR1	Set the VR1 to CCW
6.2 S meter	SSG output: 8dB /u AGC: FAST				IF	VR1	ADJ to S1
6.3	SSG output: 40dB /u				IF	VR4	ADJ to S9
6.4	SSG output: 100dB /u						Verify full scale
6.5							Repeat ADJ S1 a S9

Red are items Kenwood missed out

dBm values quite interesting to compare with other expert observations, tahts S Meters are not linear:

To: <amps@contesting.com>
Subject: [AMPS] s meter calibration
From: w7iuv@nis4u.com (Larry Molitor)
Date: Tue, 13 Jun 2000 22:57:40 +0100

At 07:45 AM 6/13/00 +0100, Ian White, G3SEK wrote:
>According to the lab reviews in the magazines, most modern receivers seem to be calibrated so that **the difference between S9 and S9+20 is pretty close to 20dB**. **Below S9, the scale looks linear** but the dB per S- point is not1 It typically takes many more dB to get from S2 to S3 than it does to get from S8 to S0 - often less than 3dB per S-point at the top end.
>It doesn't have to be that way - there are engineering solutions that could easily deliver the full IARU specification - but when everybody on HF is "five nine" anyway, who cares any more?

>
>73 from Ian G3SEK

Ian and all,
As has been said before, the manufacturers correctly assume that the majority of buyers are technical idiots. Have a S-meter that has 1 dB per S-unit and about 5 uV for S 9 is a good marketing thing. Besides it's a lot cheaper to build. I would hope that anyone who actually cares about such things would take the time to "calibrate" the meter on their store-bought radio. Since I do this with all my radios, I would not care to pay extra for a manufacture to make a feeble attempt at a real meter.

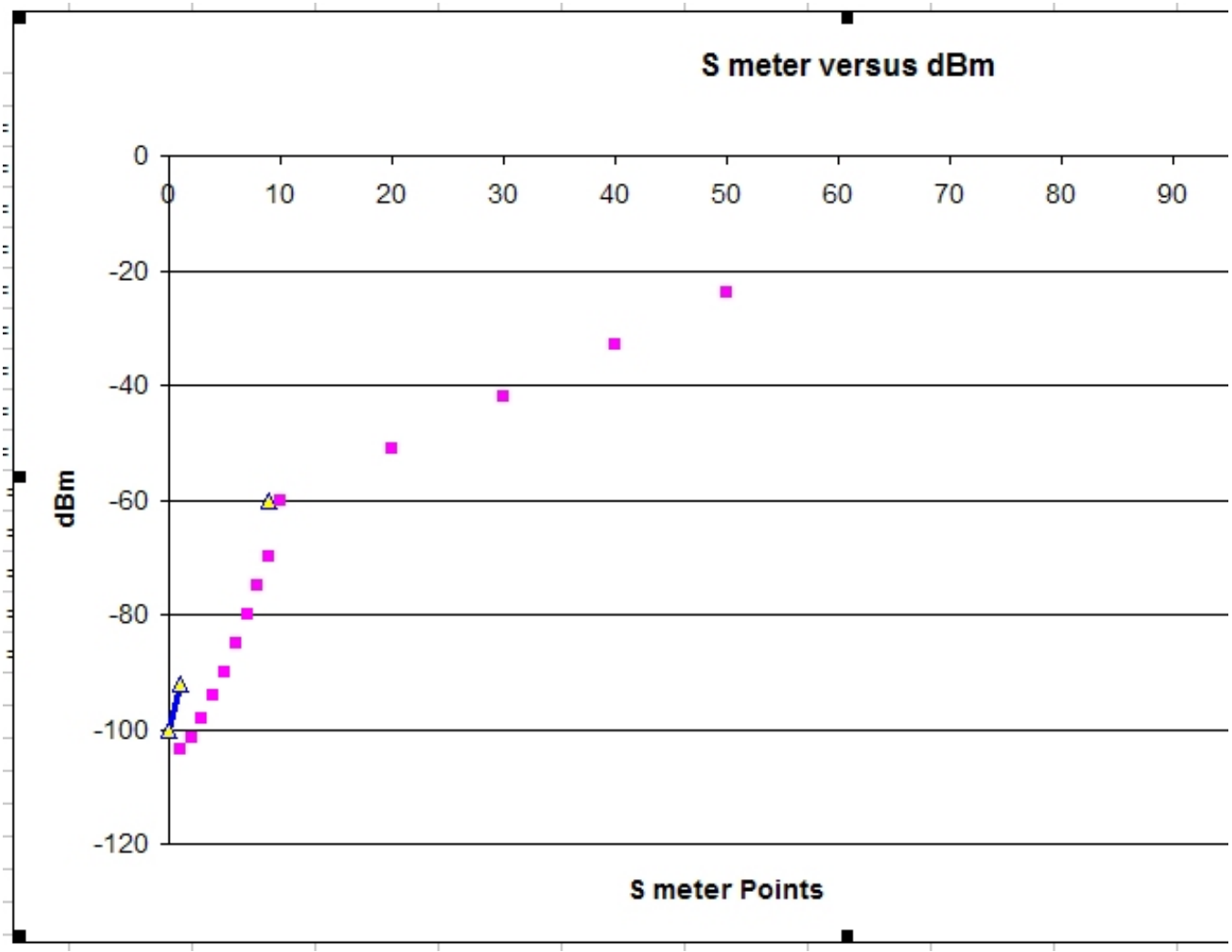
Using a HP8648C generator (at 14.1 MHz) this last time, I produced the following chart for my **FT1000D**:

S1 = -103.5 dBm
S2 = -101.5 dBm
S3 = -98 dBm
S4 = -94 dBm
S5 = -90 dBm
S6 = -85 dBm
S7 = -80 dBm
S8 = -75 dBm
S9 = -70 dBm
+10 = -60 dBm
+20 = -51 dBm
+30 = -42 dBm
+40 = -33 dBm
+50 = -24 dBm

As you can see, it's kinda poor at the bottom end, but quickly stabilizes at about 5 dB per S-unit. With S-9 being within 3 dB of 50 microvolts and 5 dB per S-unit, this particular FT1000D has the best S-meter out of the 10 or so radios I've checked.

With a chart like this handy, it gives you a real good idea just how good the other guys antenna is or how much gain his amp really has. While the guy on the other end is usually an idiot and won't believe what you tell him, at least you will know for sure.

Since it's so easy to do this, I'm surprised there aren't more folks with handy little charts for their radios. I know, not everyone has a room full of good test equipment. But I bet most people on this list know someone who does or has access to it one way or another. Give it a whirl, you might be amazed!
73,
Larry - W7IUV



PARTS

(800) 637-0388 www.kenwoodparts.com
East Coast Transistor has an online data base with part numbers: Very helpful in identifying the correct part. They also supply some parts not listed on the database.

LINKS TO USEFUL SITES

Kenwood_Japan

Kenwood Corporation
Kenwood Electronics Australia Pty Ltd
Kenwood Electronics Europe UK

K0BX Kenwood Interface HomePage
850 Repair Page
K0BX Kenwood Interface HomePage
Piexx Company - Home
International Radio Service Division
http://home.fuse.net/jg/Chips/TS940Chip.html
QSL.Net Index
Yahoo! Groups : TS-940
Yahoo! Groups : Kenwood TS-950SDX
AAvid
The Defpom Kenwood Radio Modifications Page
KENWOOD MODIFICATIONS - LINKS - XE1BEF PAGE
K0CKD's Topband/Kenwood Resources & More!
The Kenwood Archives
http://www.eham.net/reviews/detail/239
http://efjdevices.net/Problems.html

HELP WANTED

More information on the Pin Diode Improvements would be appreciated

PERFORMANCE COMPARISONS

A lot of reviews found at
http://www.eham.net/reviews/detail/239

Product Review

Trio-Kenwood Communications TS-94(

What a radio! This feature-packed box is Kenwood's newest state-of-the-art transceiver and their showpiece. Here, in one package, you will find a high-performance, general-coverage receiver; a 250-W input, solid-state, broadband transmitter; a sturdy power supply; lots of "bells and whistles" and even an optional all-band, automatic antenna-matching network.

There is more to say about the TS-940S than available space will allow. For that reason, this review will highlight some of the unique features of this radio and compare it to the TS-930S (see January 1984 *QST*).

Trio-Kenwood TS-940S Transceiver, Serial Nc

Manufacturer's Claimed Specifications

Transmitter frequency range: 160 m, 1.8-2.0 MHz; 80 m, 3.5-4.0 MHz; 40 m, 7.0-7.3 MHz; 30 m, 10.1-10.15 MHz; 17 m, 18.068-18.168 MHz; 15 m, 21.0-21.45 MHz; 12 m, 24.89-24.99 MHz; 10 m, 28.0-29.7 MHz.
Receiver frequency range: 150 kHz-30.0 MHz.
Modes of operation: A3J (USB, LSB) A1 (CW), F1 (FSK), A3 (AM), F3 (FM).
Frequency display:
Large fluorescent-tube digital main display and LCD dot-matrix 16-digit sub-display.
Frequency resolution: 10 Hz
Frequency stability: 10 PPM

Transmitter:

Power input: 250-W PEP (160-10 m bands, SSB, CW, FSK, FM); 140-W (AM).

Frequency Control

Like the '930, the '940 employs a push-button band switch. There is a button for each ham band from 160 to 10 meters, including the WARC bands. A pair of buttons, located immediately below these, allow UP/DOWN tuning in 1-MHz frequency steps. The 10 band switches in the '940 serve a second purpose. They can also be used to enter a frequency directly into the selected VFO. This is a handy feature indeed.

The A/B push button is used to select between the two VFOs that control the frequency synthesizer. The SPLIT push button allows split operation. The T-F SET button allows selection of transmit frequency during split operation. The A=B switch brings the unused VFO to the frequency in use. Rotating the weighted VFO knob at normal tuning speeds shifts the frequency in 10-Hz steps, or 10 kHz per VFO knob revolution. Turning the knob faster (over 5.5 to 6 rev/s), increases the frequency step rate proportionally.

If you like memories, you'll love the '940. Here you will find four switch-selected banks of 10 memories each. That's right—40 of your

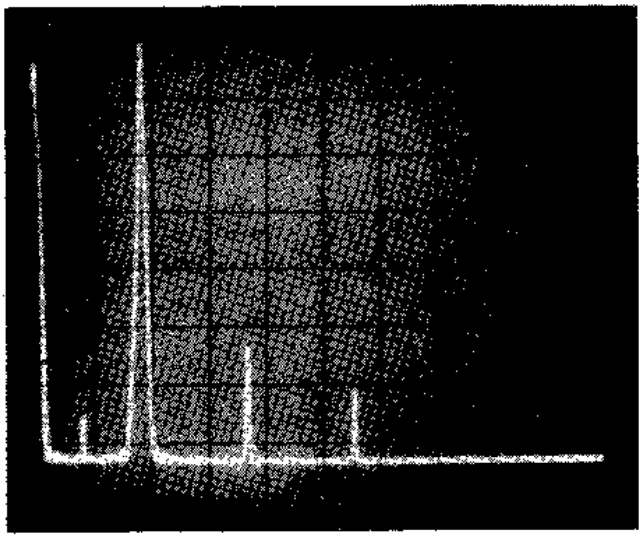


Fig 1—Worst-case spectral display of the TS-940S operating on the 160-m band. Vertical divisions are each 10 dB; horizontal divisions are each 1 MHz. Output power is approximately 100 W at a frequency of 1.85 MHz. All spurious emissions are at least 54 dB below peak fundamental output. The TS-940S complies with current FCC specifications for spectral purity.

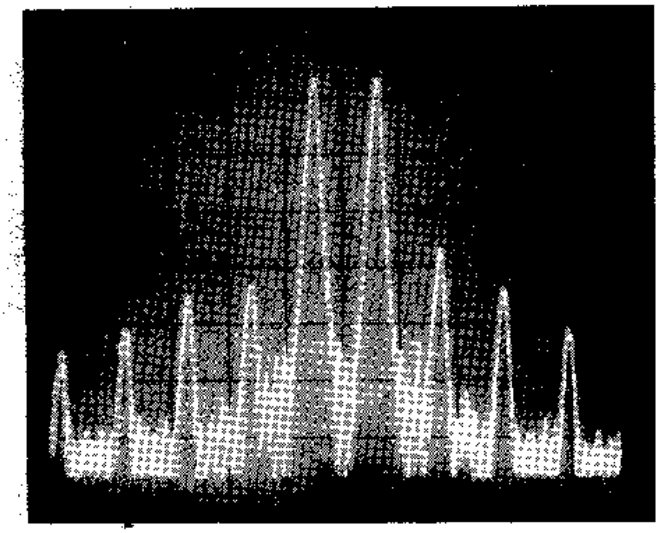


Fig 2—Spectral display of the TS-940S output during transmitter two-tone intermodulation distortion (IMD) test. Third-order products are 37 dB below PEP, and fifth-order products are 43 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. The TS-940S was being operated at rated input power on the 20-m band.

mixer. The receiver lives up to Kenwood's f reputation for producing high-dynamic-ra receivers.

As with the '930, two noise blankers are cluded. The first, with a threshold cont is effective against pulse-type noise. T second is for pulses of a longer duration, s as those annoying woodpecker (over-t horizon radar) pulses. Both blankers work fectively, but blankers can degrade recei performance under high-level signal c ditions. Judicious use of the NB LEVEL and ATTenuator controls will get rid of the nc while keeping overload problems to minimum.

Several optional filters are available for '940. There is a 6-kHz (AM) second IF fil and 500-Hz, CW filters for the second third IFs, and a 250-Hz filter for the third The CW VBT control is a continuously varia bandwidth tuning control that may be u to tighten up CW selectivity. Used with wide (SSB) filters, the VBT varies the ba width from 2.7 kHz down to 600 Hz. W either or both 500-Hz CW filters installed, VBT range is 500 to 150 Hz. VBT is especi handy for those times when the narrow fi is too much and the wide filter is not enou In fact, the casual CW operator may ne need the selectivity afforded by the optic CW filters.

In addition to IF filtering, the '940 inc porates an effective audio filter. The AF TU circuit controls a peak-type audio filter v an 800-Hz center frequency, adjustable ± Hz. This filter is useful for reducing unwar signals and noise.

Perhaps the most important feature for CW operator is the PITCH control. normal CW offset is 800 Hz. For th operators who prefer to listen to a diffe note, the PITCH control simultaneously sh the IF passband, the received beat freque *and* the sidetone pitch.

For the SSB operator, the SSB SLOPE TU controls (HIGH CUT and LOW CUT) allow dependent adjustment of the high and/or frequency slopes of the IF passband. Th controls help cut interference from stati higher or lower in frequency. In addition,

The manual covers what you need to know in plain, easy-to-understand language, and it is profusely illustrated. It is very well done, and especially useful for the beginner. The only shortcoming I found is a lack of connection details for the ACC1 jack.

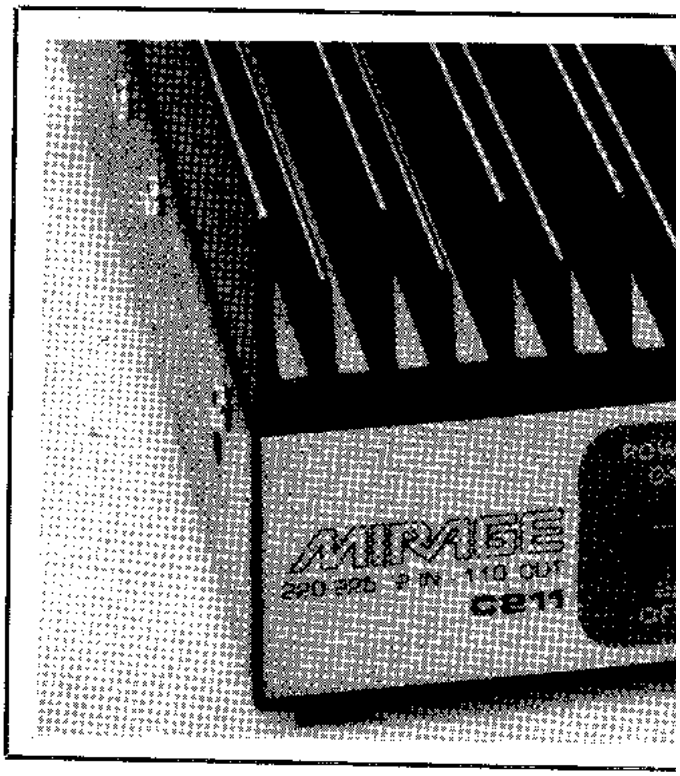
In normal operation, I found the XIT to be particularly useful and easier to use than operating split with two VFOs. Variable-speed tuning makes rapid QSYs within a band faster. These and many other features make this a significant improvement over the '930. As in the '930, synthesizer switching transients can be heard when tuning the band at a moderate-to-fast rate. These "pops" are particularly annoying when tuning across a nearly dead band.

In my opinion, Kenwood has come up with another winner in the '940. If you are thinking about buying a state-of-the-art transceiver, you should check this one out. Manufacturer: Trio-Kenwood Communications, 1111 West Walnut St, Compton, CA 90220. Price class: TS-940S with AT-940 antenna tuner, $2000; YK-88A-1 6-kHz AM filter, $60; YK-88C-1 500-Hz filter for 8.8-kHz IF, $70; YG-455-1 500-Hz CW filter for 455-kHz IF, $100; YG-455CN-1 250-Hz CW filter for 455-kHz IF, $120; VS-1 voice synthesizer unit, $40. —*Bruce Hutchinson, K8CH*

MIRAGE COMMUNICATIONS C211 220-MHz AMPLIFIER

With all the concern these days about the Amateur Radio Service keeping the allocation at 220 MHz, it's only right that we get on the band and use it. From an operator's viewpoint, it's a great band—the DX-communications possibilities are approximately the same as on 2 meters, and in many areas, the repeater segment is much less crowded. Several persistent amateurs have earned WAS and VUCC on the band. Commercial equipment for 220 MHz is not nearly as plentiful as for other bands because the market is much smaller; only North American amateurs are blessed with an allocation here. The lack of commercial equipment, especially for SSB and CW, is part of our 220-MHz population problem.

Enter Mirage Communications, a major



Mirage Communications C211 220-MHz Amplif

Manufacturer's Claimed Specifications

Frequency coverage: 220 to 225 MHz.
Modes of operation: FM, SSB and CW.
Power output: 110 W or more for 2-W input.
Input power 0.2 to 4 W.
Spurious signal and harmonic suppression: Not specified.
Receive preamplifier: 10-dB gain with 2.5-dB (±0.5 dB) noise figure.
Power requirements: 13.6-V dc at 18-20 A, nominal.
Size (height, width, depth): 3 × 5.5 × 12 in.
Weight: 5 lb.

output, a phono jack for TR control, a six-pin Molex connector for the RC-1 and two heavy wires for dc power. A 35-A fuse is provided in the dc power line. The cover must be removed to replace this fuse.

The C211 is always biased for linear operation, even when the front-panel switch is set for FM. The only difference between the SSB and FM mode settings is the TR relay drop-out time delay. The relay drops out instantly in FM, but drop-out time may be set for

TopBand: Comparison of TS940 to newer receivers
MEL CRICHTON_MELVIN_J@LILLY.COM
Tue, 15 Apr 1997 12:35:24 +0000 (GMT)
April 14, 1997
A number of weeks ago I asked the TOPBAND reflector about their experiences with newer receivers, and promised to summarize your comments
and my tests for the group.
I'm slow in getting this out because I lost some mail messages (including my own) but here's what I pieced together:
****Comparison of Kenwood TS-940 to other Receivers****
(This test is aimed at CW reception)
MY ORIGINAL QUESTION (my own comparisons are at the end of the message):
As a died in the wool TS940 user, I've been believing that the 940's receiver was as good as I could find for 160 and 80 meter DX CW, short of some of
the older rigs (like the Drake and Collins stuff). Even though copy is rough here in the "black hole" of DX, I have been able to work a number of
countries on these bands with just 100 watts. Line noise at my place is MAJOR!
Then I visited N9QCT to see his new TS-570 on a trap vertical. What I hear on the 570 amazes me. It's early evening, when all I hear at
home on 160 M is static. And his 570 is dragging in European signals above the background noise. When he kicks in noise reduction (NOT the noise
blanker) the CW sounds like it's a code practice tape! On 160! Not only that, but at the 50 hz filter bandwidth (actually about 80-90hz) there was
practically no ringing. I plan to borrow his rig and try it at my place with better RX antennas and the heavy line noise, just to get an apples/apples comparison.
So the question to recent buyers of new rigs is: Compared to your experience with older "top-end" receivers (like the 940 WAS
ten years ago) how do the new receivers stack up? I know that audio DSP will overload without a mechanical filter as well, and I saw it on Eric's 570
(he has a 500 Hz filter on order). But what about fully loaded TS570, TS870, FT1000MP, Omni VI, etc?
What differences do YOU notice?

AND THE SNIPPED REPLIES:
(R4C about same as TS940, per AA1K)
I'm a 940 user too, in a high noise urban area (1000 feet from Amtrak line and major power transmission line, etc.) but have an array of Beverages
that help overcome the noise. I've not had anything newer here to compare with, do have an R4C with Sherwood mods and find it about neck-and-neck with the 940.
Also use a DSp 59+.
73/Jon AA1K
==========
(Fixing the 940, from KM1H)
T'aint nothing wrong with the TS-940 that a little work won't cure Mel. Depending upon the serial number (8 Million a rough cut-off) there are
many to some mods that really help. Private E-Mail me for specifics. (KJ9C NOTE: MY 940 IS ONE

OF THE NEWER ONES, SO THAT AIN'T THE PROBLEM)
Also by changing about 45 diodes over to PIN's there is a dramatic performance improvement in RX performance. I also use cascaded IRCI
filters for both CW and SSB...the Kenwoods have poor skirt rejection.
I have 4 940's here that are used fm HF thru microwaves as platforms for transverters. I quickly sold a FT1000D as not worth the money that 2 well
modified 940's could perform at.
I had a TS870 here on loan...it has a great RX but very prone to overload on 40 thru 160.
GL and 73 Carl KM1H 261 DXCC on 160; 309 on 80

(Comments from George Guerin..K8GG)

1. My experience with the TS-940 is it does not hear as well as the TS-930 or TS-950SDX. Also there is generally a spike on the leading
edge of the first CW character sent which risks grid damage to tubes like the 8877, 8874, 3CX800A7, etc.
2. Your description of the TS-570 sounds very good. Maybe they will make a TS-970 soon??
3. I hear there are problems with the TS-870, because there are no filters at all, except digital in the last IF. This creates birdies
in the pass band, since it is at something like 14 or 17 Khz, and a signal 28 or 34 Khz away can leak through. I hear one W6 added
filters and cleaned the birdies, but Kenwood will not do this on production units, so we will have to wait for a TS-871 or 880?
4. I have used the FT1000MP and it does a pretty good job, but I haven't put it side by side with other radios. Setting the two DSP
controls on the concentric rotary switches is a bit tricky. The dual receive and or split is very good and easy. A friend in Chicago says
it hears better on CW than the FT1000D and the TS950SDX. On phone I like the TS950SDX best, but that is not true 160 operation.
5. I would like to try the IC-775. More money, but the automatic carrier null is very fine. On CW, I would like to try one on 160 for a while myself, and see about the noise removal system.
6. I understand TenTec has a Omni 6+ just out with dsp. I have no way of trying it and the TenTec "chemistry" and my body chemistry do not
get along, so I will never buy one. I do have friends on 160 with Omni 5 and Omni 6 radios doing well. They do have good beverages.
One has a directional vertical array!! I do have a TenTec tuner I like a lot. There is no chemistry problem without electronics inside
the box! HI !

George Guerin

[NE3H compares the 940 to the Omni VI (not the VI+)]
On the OMNI .. no question, best receiver that I've ever heard. Yes, I think the FULL DSP receivers may be more sensitive ... or have lower
noise floor .. but none of the HAM gear that I am aware of ..
I cannot hear the diff between my old 940 and the OMNI .. if normal ambient noise, most people cannot hear the diff. The outstanding
characteristic.. and the second reason I got TWO OMNIs .. is that you can have an S9 + 20 signal next door to one in the mud .. and it does
not make a difference. I have a neighbor .. a mile away .. who runs a kW on RTTY .. (as do I) and we can op within a Khz or two without
disturbing each other.
Fact is, if you have lots of line noise .. I don't think you'll notice the diff in rcvr sensitivity. The noise

blanker on the OMNI is about as
effective as any .. but I don't think it is better than the 940 re noise blanking. But Yes .. the front end does not 'Block' in the presence of a loud signal next door ...
The second reason that I went for the OMNI is that it's signal on CW / QSK (at high speed) is distinctly better that anything else .. save the Icom 781 that I've heard anywhere else.
The fact that you can cascade filters on the NEW OMNI PLUS really makes me twitch .. I've already signed up to do the full upgrade to my radios. I have a 500hz RTTY filter in the 9mhz path .. after the mod .. I'll be able to have a choice of the RTTY filter or the CW filter .. I think that is
a real advantage ..
Of course, stacking of filters is pretty nice on the FT1000 stuff too ..
The OMNI operation is pretty intuitive too .. it has less bells and whistles .. but I can't think of any I miss (from the old 940s).
Remember that 98% of my operation is CW and RTTY.
de joe

(comments from K3SME)
Were you able to borrow the rig and try it at your QTH? I have found that 160M performance is very QTH specific. I have borrowed "goodies"
like DSPs which knocked noise down ALOT at my buddy's QTH but didn't do much for my noise here as an example. One of the locals here in
Maryland picked up a 570 about 2 months ago and after a week said it was pretty good but he HAD to get the optional filter to make it decent on
low band CW for receive. Have you had other comments? The few guys I know with OMNI V and VI praise them highly for low phase noise and
tremendous RX capabilities. I am using a TS830S. It replaced a Drake 4 line. Tough to keep up with technology and I refuse to pay for a 100
memory tranceiver when I don't need all those bells and whistles.
73, Sid.

(K8GG asks about the 570, comments on TS950)
Have you read the review by Doug DeMaw, W1FB in the March 1997 issue of CQ Magazine? It reads well but raises the questions I have
written here below:
1. I wonder if the only way to get a beverage hooked up is to change antenna selections on the front panel?
2. I also wonder if there are plug in slots for more than one extra filter? I don't need a 1.8 Khz SSB filter with slope tuning, but I would like to have both the 500 and 270 Hz filters in the 8.8 MHz IF.
That is one complaint about the TS950SDX: There is room for both the 500 and 250 Hz IF filters in the 455 Khz IF, but only one CW filter in the 8.8 IF, and it is more important to have selectivity in the first possible stage (2nd IF) rather than in the next stage (3rd IF).
Obviously, it does not have the DSP available in the TS570!
I may send Doug an SASE and note and see what happens. He now lives maybe 175 miles NNW of me.

73 GL George K8GG

(Another comment from K8GG George Guerin)
As I saw the TS-870 show at the W9DXCC a couple of years ago, there are NO IF filters. That model uses digital filtering at about 17 Khz
to shape the passband. Problem is the images 34 khz away!
There is no plan to put in filters, although a couple of California hams have done it. (WONDER

WHO?) With out a 2.7 Khz filter at the 8.8 or 455
IF, it has troubles from what I know.
Kenwood is NOT planning to make filters optional. I do understand using the SSB filter and digitally making the CW filter in the 4th IF
works fine.
On the TS-570: Is there an accessory socket like the TS-940 and TS-930 that has the ability to pull out and put back in the RX antenna
line? (SEE ANSWER BELOW)
That is my fear! The Icom radios like the '740, '751A, '765 and '775 all have a coax jumper for the RX antenna line. The '728 and '726 do not!! I complained to the Icom rep's at Dayton.
The TS-950SDX has a jumper like most of the Icom radios.
There is a guy in Ft. Wayne who makes FEP's - front end protectors. If you can figure a way to bring out the RX antenna line, it is a neat
way to make sure the RX input is grounded on transmit. It is written up, but not in enough detail, in one of the recent CQ Mag's as well. That might help, but toggling the front end on each "over" is a true pain!!
Have fun, 73 George
==========
MY OWN TESTS, Side by side with TS-940... KJ9C
>From what I saw of my friend's 570, and from his comments, the CQ article is on the money
To switch antennas one must MANUALLY hit the ANT switch... so that's one hit for transmit, one to receive when using a beverage... I have not yet
looked for a transverter input on his rig, as that is how my TS-940's external RX antennas are wired,... when I get the rig at my place I will
check for features... but I know there is NO dedicated RX antenna input... this would keep me from buying a 570, but I guess I could build
an external TR switch like we built back in 1968 for club's S-Line.
There is room for only ONE filter... so decide whether it's SSB or CW, 500 or 270... that's a big drawback but would not keep me from buying a
570, as I would likely go for the single 270 for IF protection... but one in each IF would be nice... I guess the TS870 has room for NO IF filters
Written later:
I borrowed the 570 for a few hours and installed it with antenna switching next to the TS940 at my NOISY QTH (line noise on some antennas as high as 20
dB over S9). In every case the 570's noise REDUCTION unit did a better job of reducing noise and bringing up weak signals (most tests on 160 and 80
meters where my noise is worst). The noise blanker also worked, but the digital reduction was better. On the contrary, the noise blanker on the 940 seems to
be a little better than the 570's. However, as you know, strong signals tend to swamp receivers with noise blankers ON. The 570 noise REDUCTION beat the DSP59+ NR feature.
The 570 was tested without an IF filter installed, and it did exhibit some overload from adjacent signals... since then, Eric has installed a 500 Hz
IF filter and reports that adjacent signal swamping is negligible, and he can crank the DSP down to 100 Hz without ringing.
The DSP is the selling point of this receiver... better signal to noise than the 940 (with STRONG noise) and therefore can dig out the weaker ones.
However, in the absence of strong line noise (say S3 or lower) the TS940 with outboard DSP seems to work pretty well. See below.

The CW autotune works with relatively weak signals, but not down in the mud. This makes tuning with tight bandpass a lot easier.

Very little SSB testing, but the heterodyne filter works as good (or better) than the one on the 59+ DSP. Did not have multiple heterodynes to
see how it works, but would guess OK.
Forgot to check for transverter input!!! Dope! Suppose that auxiliary receive antenna is possible somehow.
COMPARISON OF TS940 TO YAESU 1000MP:
I borrowed K9IG's 1000MP for similar testing. I felt like I should sign away rights to my firstborn grandchild if I damaged it, so better believe I
was REAL careful with it and read the manual first!! But Greg seemed unconcerned that I was driving away with HIS 2500 dollar radio in my truck.

I set up similar to the TS570 test, and as luck would have it the power company chose to temporarily fix the line noise (after five months!!!) that
day. With all the mechanical and DSP features kicked in (including a DSP59+ on the 940), the TS940 and the FT1000MP performed about the same on 160 through the other bands (CW only tests). Some of the controls WERE tricky, and the preset filters on the 1000MP took some getting used to. There must be about two million bells and whistles on the 1000MP, and my fat fingers found a few by accident. It is an impressive rig... but without line noise, not enough to make me dump the old 940. Without the noise reduction, the 940 is OK.

One thing I noted... small point... S meter readings were comparable for both rigs at low signals and noise levels... but S meter readings were higher
on the 940 for stronger signals... of course, that does not mean much, as an S meter ain't that accurate... just needed more attenuation with 940.

I packed up the 1000MP and got it ready to take back to Greg (about 8 miles from me)... then Indianapolis Power and Light came through just in time!!!
Line noise returned, but only at S9 levels. I quickly patched the 1000MP back into the setup and compared reception. In this case (with strong line
noise), the 1000MP was better at pulling weaker signals up out of the crud. Even with noise blanker on, the 940 lost some of its ears. Noise blankers on
both rigs eliminated the noise HEARD, but the 1000MP was better at finding signals and bringing them up than the 940 with DSP59+ was.
4/15: Bill Tippett reports that his 1000MP is extremely clean (no intermod products observed) compared to the TS930 he retired.

COMPARISON WITH OMNI VI+
I wanted to test an Omni VI+, but none to be borrowed locally, so I asked NE3H for his opinion (see above). In the meantime, power company has repaired a number of defective lightning arresters, a bad transformer, and God knows what else to the point where my line noise is now S3 or less most of the time..so the 940 gets a reprieve. I fact, even though it's almost too late in the season, am working DX on 160 most evenings now when I could not hear it in winter!!! With a little luck I might hit 50 countries for the 96-97 season.
I wish I could find the mail messages I sent to George because there was more specific info in them... but this report is the bottom line. From my own observation, the 1000MP and the TS570 outperform the TS940 receiver with high line noise levels. Mechanical filters are needed on both rigs. But with little line noise the 940 is still pretty dang good.
Thanks to K9IG (formerly KO9Y) and N9QCT for the loan of their rigs.

Mel KJ9C

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FAQ on WWW: http://www.contesting.com/topband.html

-----Original Message-----
From: kenwood-bounces@mailman.qth.net [mailto:kenwood-bounces@mailman.qth.net] On Behalf Of Mike McCarthy, W1NR
Sent: Wednesday, 13 July 2005 1:13 a.m.
To: Philip Neidlinger; kenwood@mailman.qth.net
Subject: Re: [Kenwood] "New" TS-940S
----- Original Message -----
From: "Philip Neidlinger" <PNeidlinger@dwginc.com>
To: <kenwood@mailman.qth.net>
Sent: Tuesday, July 12, 2005 8:45 AM
Subject: [Kenwood] "New" TS-940S

>Yes I know the 850 is probably a better rig, but I like to have an analogue meter on my radios.

No it's not! The quad conversion of the 940 blows the doors off the 850.
I've used them side by side.

Mike, W1NR

MODIFICATIONS

POWER SUPPLY IMPROVEMENTS

-----Original Message-----
From: John [mailto:hydroaction@cfl.rr.com]
Sent: Sunday, 10 April 2005 3:06 a.m.
To: jaking@es.co.nz
Subject: Re: Advice on what to do upgrade TS-940 PowerSupply

First thing

Replace all the Zener diodes on the AVR board with 1 watt Units. Same voltage values. you will have to open the hole up slightly to allow for larger leads on new parts

D-3
D-4
D-8
D-9
D-14

D-1, 2 ,10-13 are all ok ... just leave them. They are 2.5amp at 100Vpiv

Q-1 and Q-2 , Q-6 are fine. Just replace them with same.

replace C-3 ,C-4,C-6 with 2200UF 50volts , replace C-13 too.

Put a 47 ohm 1/2 watt resistor in series with the collector of Q-6 to limit inrush current on turn on.

Replace the pass transistor Q101, Q102 with 2N5886 .....if these short it puts 42 volts on final unit and burns out the expensive driver transistor in about 30 seconds

Resolder the complete board & deflux it too.
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Observations by ZL4AI

Original Diode Specifications:
ZL4AI thinks the file below gives MTZ diode operating values.
MTZ specs MTZJ_LESHAN.pdf

Possible Replacement Diode Specifications:
1n_Formosa.pdf
1n_General.pdf
1N_JDG.pdf
1N_Leshan.pdf
1N_Rectron.pdf
1n47__Vishy.pdf
1n4728A to 1n4753A Hitachi.pdf

bzx85C__Fairchild.pdf

	Original	Original 1	Original 1	Measured in service at:	Replacement 1	Replacement 2	Measurements tak replacement
D1, D2, D10 to D 13					1N5404 [400V 3A]	1N5408 [1000V 3A]	
D4	500 mW				1N4742 1W 12V	BZX85C12 1.3W	
D8	500				1N4746	BZX85C18	

	mW				1W 18V	1.3W 18V	
D14	500 mW	MTZ22JD 19.72v to 20.72v	MTZ24JA 22.05v to 23.18v	ZL4AI measured for diode 'marked 22D', 22.8v DF5KF measured 22.7v	Hitachi 1N4748 1W 22v +- 5% 21v – 23v Leshan 1N4747 20v +- 5% 19v – 21v	Fairchild BZX85C22 1.3W, 22V	ZL4AI put in 1N4748-209 and measured at pin 5-21T on AVI see AVR_D14_replac

D9 is difficult to find a replacement match for
Kenwood Original is MtZ 9.1 JA which has voltages between 8.29 -> 8.73 median = 8.53V
Kenwood alternative part is MtZ 8.2 JC which has voltages between 8.03 -> 8.45 median = 8.24V

Possible replacements
1N4738 8.2 V +- 0.5V
1N4739 9.1V +- 0.5V

Installed and measured I found
1N4738 output 7.27V at AVR terminal 9 pin 8 ie. 0.63 Volts too low
1N4739 output 8.31V at AVR terminal 6 pin 1 ie. 0.31 Volts too high

D9 only supplies the liquid crystal display and the remote control IC in Digital A, it is very unlikely to have 0.5 watt drawn from it. Very few 940s have the remote control chip installed. My conclusion was it was best to leave in the original diode putting out 8.0 volts.

From Eham
RE: Kenwood ts 940s avr board Reply
by N0XWR on February 28, 2006
you won't find an AVR board for sale new. you should endeavor to fix the one you have. first, check regulator Q103. it is in the rear left corner of the rig as the rig faces you. it is on the heatsink for the power supply. there are three regulators side by side. it is the one on the far left. no matter whether you replace it or it is good, it is imperative that you cut the connector off of the three wire harness that plugs on to regulator Q103 and solder directly to it. this harness comes from plug-in #2 on the AVR. over time the connector overheats and fails and cannot carry the 20-30 volts to and from that regulator. i have seen the problem many, many times. when the connection to that regulator fails, it takes out Q6 on the AVR board, so check it next. clif at AAvid, now retired helped me get through the problem. also check D3, D9 and D14 which are zener diodes on the AVR board. they can be checked right on the board with a multimeter. the board can be removed easily. as you unplug the wiring harness use a sharpie and number each connector so that you can reinstall it easily. make a diagram, too. use small long nose forceps to

unplug the connectors to the AVR board. Incidentally, Q103 is part #NTE377 available at mouser. Q6 is part #NTE382 also available at mouser. i have the part numbers for the zeners if you need them. 73s Jerry N0XWR

ALC DELAY TIME:

This mod to your TS-940 will change the ALC delay time from approximately 1 sec to 0.022 second. This means that the ALC
will no longer impose its own time characteristics on your audio response; the ALC will now follow your own sylabbic
rate amd emphasis. Usually the average power output will increase which will drive a linear amp harder.....(at least
those meters will swing higher!).

The TS-940 has a 10uF cap (C31) and 100k resistor (R104) which make up the time constant for the ALC. This tends to
reduce the output power for the duration of the ALC time constant (or till the circuit charges up again). Then it starts all over again on the next word.

This procedure allows modification to the Control PCB (X53- 1420- 11) in the TS-940 WITHOUT having to remove the PCB. Remove the bottom cover and locate the Control PCB. Locate R137 and R104. These are located in the upper right hand corner as the rig faces you upside-down (near VR3). A Service Manual would be very helpful for locating parts!!! using a knife edge or similar, carefully scrape off the insulation from the top of the two resistors. Tack solder an 1/8 watt 2.2k ohm resistor from the top of one to the top of the other. Put the cover on and it's finished.

TS-940 AVERAGE OUTPUT POWER SSB

On the air conversations concerning a kenwood newsletter mod to change ALC delay time called for putting a 2.2k ohm across the top of r137 and r104 on the control p.c.b , along with a .47 mfd cap between pin 1 and pin 2 of connector 8 on the control board. The mod is excellent except .47 mfd is far too much. instead use a .005 to .01 mfd to keep from over driving. electrolytic not necessary, but if used, make sure nagative goes to shield wire pin..

USE OF TS940S FSK RECEIVE FOR HF PACKET

TS940S owners may wish to use FSK mode for HF packet. FSK cannot be used for Packet transmit because the shift is 170Hz, and Packet requires 200Hz shift. This necessitates using LSB with AFSK. I'm not aware of any way to adjust the shift, and 170Hz is required for FSK on AMTOR and RTTY. It would still be nice to use FSK for receive, the primary advantage being the availability of CW filters which are inaccessible in LSB mode. By using the SPLIT capability you can use LSB for transmit and FSK for receive. Tune in signals with VFO-A on LSB. Then press A=B, switch to VFO-B, enable FSK, enable RIT and tune the offset to exactly -2.3KHz. Then enable SPLIT. When listening to signals, depression of T-F-SET will allow you to listen alternately with each VFO; the signal tones should be identical. If they are not, adjust the RIT on VFO-B (FSK mode) until they are. Optional CW filters are switched in by selecting the NAR ("narrow") filters with the NAR/WIDE switch (LED indicates NAR).

I have found that this arrangement works quite well, and enhances the readability of received packets, especially under heavy QRM and fading. It is easier to adjust the CW filters (NAR/WIDE and VBT in WIDE mode) than the SSB Slope Tune controls.
I would like to hear from other TS940S users who have tried this technique or others that enhance HF Packet operation. Send replies to WA1FMM @ W8AKF.
73...Dan / WA1FMM / Thousand Oaks, CA.

INQUIRY REGARDING USE OF ADDITIONAL RECVR.

I would be most interested in getting Information on how to use an additional receiver at the same time as the TS-940S is in operation (receiving, of course). (ED Note: We covered adding another receiver to 930, Issue 59, Page 54.) The User's Manual covers use of an additional receiver in lieu of the receiver of the 940 receiver section. I am the owner of a 75A4 which I've modified and updated over the 30 years I've had the receiver, and I find no other receiver comparable to it in many most significant ways. So I would very much like to know how to connect the 75A4 into the TS-940S for use simultaneously with the receive section of the latter. If this subject has already been covered in a previous newsletter, please tell me how to get a copy. (ED Note: Nothing published on this in back issues.) I'm confused as to whether I need to cut diode
130 and 135 on digital Unit B in order for the Xcvr to operate over the same frequency range as the receiver. Somewhere I noted that only diode 130 need be cut. (ED Note: Kenwood Newsletter No. 54 clearly states: D135 is for MARS frequency only. D130 is for Gen.Cover- age Transmit.)

GEIL CHIP

a chip available from Giehl electronics in Cincinnati that will slow the tuning rate to 2 khz per revolution on the main dial of a kenwood ts-940

FEEDBACK FROM READERS

-----Original Message-----
From: DGB [mailto:dwibos@netnet.net]
Sent: Tuesday, 5 April 2005 6:46 p.m.
To: jaking@es.co.nz
Subject: Re: [Kenwood] TS-940 Full description of AGC timing improvement which significantly improves receiver performance

>
Excellent job on your efforts/compilations Jeff.

73 Dwight W9YQ

-----Original Message-----
From: Curtis Benjamin [mailto:benjamic@michigan.gov]
Sent: Wednesday, 11 May 2005 1:39 a.m.
To: jaking@es.co.nz
Subject: Thanks

Jeff, thanks for setting up the TS-940 page. I hope it "takes off" and becomes "the" spot for '940 info.

Curt

-----Original Message-----
From: Ed [mailto:ca.urso2@verizon.net]
Sent: Monday, 23 May 2005 7:18 a.m.
To: jaking@es.co.nz
Subject: TS-940S Reciprocal Mix.Noise Mod - Correction

Jeff:

Congrats on your fine TS-940 Web Page. Keep up the good work!

I wish to point out a text error in the letter from Rich, WZ4Z, regarding resistors R120 and R129 in the PLL Unit which should be corrected to 3.3KOhms each, NOT 3.3 Ohms as stated. This refers to a Kenwood fix given in their Bulletin 917 dated 3/2/87.

Also, your AGC Timing Correction was applied on my rig (SN 806XXXX) and worked great! Sure enough, resistors R149 (68K on my equip) and R150 2.2Meg had been incorrectly installed by the Mfr. The board markings for those resistors were wrong.

I am also following with great interest the developments regarding FETs reversals noted by PY1NR.

73,
Ed Alves KD6EU
USA

-----Original Message-----
From: EL34GUY@aol.com [mailto:EL34GUY@aol.com]
Sent: Thursday, 2 June 2005 3:37 p.m.
To: jaking@es.co.nz
Subject: ts-940 stuff

Hi Jeff,

Im getting my first 940 hopefully sometime next week. Ive been reading your website and it has some very helpful comments and recommendations. How hard was it to make the resistor mods you describe on the IF board? Also, I found an SO-1 for mine, how difficult are they to put it? Have you done any pin diode modifications? Thanks for the great website, 73

Mark
W0NCL

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-----Original Message-----
From: Traian Belinas [mailto:traian.belinas@deck.ro]
Sent: Monday, 13 June 2005 5:05 p.m.
To: jaking@es.co.nz
Cc: eduardo@guisard.com; 'thomas hohlfeld'
Subject: Re: TS-940S - Some few considerations

Hi all,

Jeff, thank you for keeping me informed about the TS940 work and about your website, and please continue doing it...
Please also pass any usefull info to me also, I am interrested about.

Using switches for comparison of the normal/reverse FET state may be not feasible, even in the case of using shielded cables.
The added hardware (switches and cables) will unbalance the mixer in the case of Q4 or may cause other Rx problems in the case of Q10, so the comparison may not be made this way or can be irrelevant.
A better aproach shall be using hole contact pins for the FETs and reversing them one or another position for comparison.
Don't let the contact pins there, don't forget removing them as the Q10 runs at high drain current, and so it runs normally very hot and its cooling is made mostly by the terminals conduction and by the PCB traces path....

Tnx & GL,

73,
Traian Belinas, YO9FZS

-----Original Message-----
From: Jeff King [mailto:jaking@es.co.nz]
Sent: Sunday, 12 June 2005 5:34 p.m.
To: 'eduardo@guisard.com'
Cc: Traian Belinas; 'thomas hohlfeld'
Subject: RE: TS-940S - Some few considerations

Hello Eduardo,

Thanks for the email. As you will see last year on your comments page I was very inspired by your discovery.
I was like many 940 owners very excited.
After doing the research, on my web page I was disappointed to find that turning q10 allegedly made the front end unstable.
So for that reason I have not done that.
Have you any more information on turning q10 around?

I have turned q4 around on my radio.

In the end I am drawn between two view points

- 2SK125 FETs function the same in both directions as Thomas has measured, so turning then\m around makes no difference [the scientific view to which I subscribe]
- 2SK125s make a lot of difference turned around, which makes the radio overload with the resulting gain.

Here is suggestion that you could carry out to prove your point, and publish further.

If you connect the D + S leads of the 2SK125 to a shielded lead and a switch so that the switch in one position is the normal factory setting, and in the other position it is the PY1NR setting then you could swap the positions while listening to the radio and verify just how effective the reversal is. You could report it by S point variation on switching.
If you could prove the point more, all hams would be very appreciative, of your good work.

This could be done for both Q10 and Q4 … 2 different switches. These could be mounted on the right side of the top hatch, and act as more adjustment controls for the 940.

I thought about doing this for R149 and R 150, but decided it was not necessary. Now with R149 and (150 swapped, I have to turn on 10dB or 20dB attenuation to diminish a strong signal.

Re solder joints and connectors. I already have a section about this on the web page. It needs more work and more information on soldering especially. You of course are correct about that but it is a separate matter to reversing the FETs.
There is another possibility. I actually fund on my PLL board a missing trace!!!! Wow. This meant the oscillator never worked on my radio. I'm sure some other 9404s also have this problem.

Yours sincerely
Jeff King zl4ai

-----Original Message-----
From: Eduardo Guisard [mailto:eduardo@guisard.com]
Sent: Sunday, 12 June 2005 9:28 a.m.
To: jaking@es.co.nz
Subject: TS-940S - Some few considerations

Hello Jeff,
PY1NR asked me to also say that he modified 2 (two) TS-940S, from 2 different originations. The same improvements of gain and AGC were found. He cannot precisely measure the gain improvement due to poor instrumentation.

He also wants to emphasize that is very important to fix all contact fails (very common in many TS-940S). The contact fails could "mask" the improvements that the modification may occur.

There's another Brazilian ham that did the mod and found no difference the first time. But later on he found a defect on the VR2 trimpot. After this correction he got 6 dB more at 1,8 Mhz and 12 dB at 28 Mhz. It's also very important to fix all eventual defects before the make the mods described by PY1NR.

Thanks and regards
EG - PY1BR

-----Original Message-----
From: Eduardo Guisard [mailto:eduardo@guisard.com]
Sent: Saturday, 11 June 2005 10:51 a.m.
To: jaking@es.co.nz
Subject: TS-940S

Hello Jeff,
I read the comments about the FIELD EFFECT TRANSISTORS AROUND THE WRONG WAY.
I am PY1BR and together with PY1NR, we include all details about this MOD in my website www.guisard.com. The error was found by PY1NR.
We know that in some cases the differences in the Rx performance or gain may not be important if you correct the FET position on the PCB.

Please, let everybody know through your homepage about all comments we received from many Hams in http://www.guisard.com/Index_reviews.htm.
There are many people around the world that agree with improvements after the FET's correction.
Thanks and regards
EG - PY1BR