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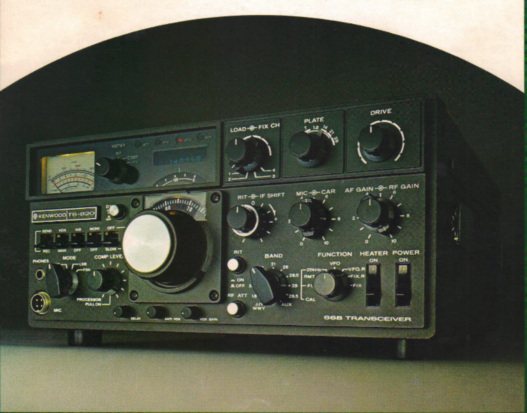
Technical Information TS-820



KENWOOD

The New TS-820

KENWOOD's HF Transceiver, TS-520, is known as one of the finest transceivers on the market and has gained a world-wide reputation for its high quality, outstanding reliability and moderate price.

THE TRIO-KENWOOD CORP. has developed another professional type SSB transceiver, the TS-820, backed by our many years of successful experience and "know-how", as well as the most advanced electronic technology.

This newly developed transceiver is designed to cover a wide range of frequencies, from 1.8 to 29.7MHz, providing the utmost in performance. It features an accurate dial comparable with a frequency counter and provides trouble-free, easy operation.

Important points in Development of the TS-820

The KENWOOD TS-820 was developed in consideration of the following important points:

1 All the factors required for SSB transceivers to maintain maximum performance should be analyzed again and again. Spurious and cross modulation distortion should be minimized during transmission; active measures should be taken in the receiver section to improve the two-signal characteristics (cross modulation, sensitivity suppression, etc.) as well as the sensitivity and image ratio and to minimize interference; all the controls, knobs and dials should be designed on the basis of human engineering technology.

2 Latest techniques should be thoroughly analyzed for their merits and demerits and introduced without adhering to conventional techniques.

3 In order to improve the reliability and servicing and to provide users with products that can be easily operated anywhere, as noted in KEWWOOD's motto, all the data obtained from marketing and production fields should be thoroughly analyzed by a computer, besides performing the conventional life and environment test.

4 All the features added to the TS-820 should be fully studied so that they can be effectively used during operation.

To meet the above requirements the TS-820 was designed so that the signal circuits of both the transmitter and receiver sections are quite simplified with the employment of the single conversion system for improved linearity and the PLL type local oscillator system for excellent spurious rejection. This has facilitated the use of an IF SHIFT circuit and mono-scale dial.

Among other features of the TS-820 are the DIGITAL DISPLAY (optional) that displays accurate operating frequencies not containing errors from the local oscillator frequency and RF SPEECH PROCESSOR (built-in) that makes the TS-820 a very effective transceiver.

Since the TS-820 employs the latest techniques and advanced features and is designed for practical use, we are very confident that it provides outstanding performance and dependiability.

Features of the TS-820

1 The PLL type HF band transceiver

The PLL type HF band transceiver covers the frequency range of 1.8MHz to 29.7MHz (AUX band and 15MHz WWV/JJY included) for SSB, CW and RTTY operations.

RTTY mode can be easily switched to NARROW (170Hz) or WIDE (850Hz). Automatic power selector system assures the user of many hours of continuous operation.

2 Minimum Spurious and Excellent Two-signal Characteristics

The employment of an FET balanced type mixer in the transmitter and receiver sections, the MOS FET and single conversion system minimizes spurious radiations during transmission and provides excellent two-signal characteristics during reception.

3 IF SHIFT Circuit (PASS BAND TUNING)

The IF SHIFT circuit is a circuit to shift the pass band of the IF frequency without changing the receive frequency. The pass band can be shifted to eliminate interference or the receive frequency characteristic can be set to the desired band with one control knob.

4 RF PROCESSOR

A unique, high performance speech processor is built in the transceiver. Its compression function is effected by a quick time constant at 455kHz. Since an RF process system is used, distortion is minimized and tonal quality is not deteriorated.

5 RF NFB in Transmitter Final Stage

To improve cross modulation distortion during transmssion, an RF NFB is applied from the transmitter final stage to the driver stage. The use of amplification type ALC further improves the quality of signals.

6 Newly Developed Mono-scale Dial

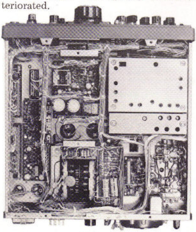
The mono-scale dial is already used in the professional type transceiver, TS-900. The design of this dial is now further improved and is used in the TS-820. The newly developed mono-scale dial incorporates a sub-dial to facilitate reading of frequencies. The dial indicates accurate frequencies on one dial pointer for LSB, USB and CW operations.

7 Use of Digital Display (DG-1: optional)

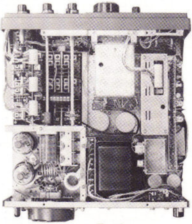
Conventional display systems that use the VFO frequency alone, the transmit/ receive frequencies do not deviate even when the carrier or local oscillator frequency deviates.

But the digital display for the TS-820 uses carrier signals, VFO signals and local oscillator signals to indicate accurate transmit/ receive frequencies throughout the entire band and mode.

Since the display accuracy is determined by the 1MHz standard oscillator, the operating frequency can be read to the accuracy of 100Hz order by calibrating the oscillator signal with WWV/JJY. The displayed figures are illuminated in blue to provide many hours of fatigue-less operation.



Bottom view



Top view

8 D.H. (DISPALY HOLD) Switch
By pressing the D.H. Switch, the frequency indicated on the digital dial remains unchanged, thus being used as a frequency memory system.

9 Rigid Construction and Easy Operation
Like the TS-520, the transceiver is built with a die cast front panel and a rigid chassis to provide sufficient mechanical strength for mobile operation.
The vernier type PLATE/LOAD TUNE mechanism, neatly arranged knobs, based on human engineering design, and easy-to-read dial scale offer maximum convenience for operation.

10 SSB Monitor Circuit
The transceiver is equipped with a circuit that allows the operator to monitor his own voice during SSB transmission. This is very useful when used during adjustment of the built-in RF PROCESSOR.

11 SSB/CW Audio Frequency Characteristic Changeover Circuit
During CW reception, the audio frequency characteristic is automatically narrowed for comfortable tonal quality (Fig. IX-3).

12 Fixed Channel Circuit (crystals are optional)
Four additional fixed channels can be inserted in the transceiver. The RIT feature in the fixed channel circuit permits the receive frequency to be varied by ±250Hz. Operation with an external VFO is also possible the same as the TS-520.

13 Wide Variety of Accessory Terminals (REAR PANEL)

* Transvertor connecting terminal for TV-502 (2m) and TV-506 (6m)
  Transvertor is readily operated by simply connecting a cable.
* PHONE-PATCH terminal
* IF OUT terminal
* RTTY terminal
* External VFO terminal
* Linear amplifier control terminal

14 RF Attenuator
The receiver circuit of the TS-820 is fully protected against the effect of large input signals by the use of the RF ATT that attenuates the signals by about 20dB.

15 Use of Newly Developed Tube S2001A in the Final Stage
The final tube, S2001, formerly used in the TS-520 is replaced with an S2001A having increased maximum plate loss (35W) and thermal strength, thus assuring improved reliability and longer life. It is interchangeable with the S2001 or 6146B.

16 Built-in AC Power Supply
Like the TS-520, the transceiver is equipped with its own built-in AC power supply so that it can be operated simply by connecting the microphone and antenna. A DC-DC Converter (Model DS-1) is available as an optional accessory for mobile operation.

17 Other Features

* Built-in crystal filter type, high performance noise blanker.
* Built-in marker oscillator (25kHz)
* VOX circuit
* SIDE TONE circuit (SEMI BREAK-IN possible)
* Heater switch
* 3-position AGC switch (OFF, FAST, SLOW)
* Built-in silent cooling fan

TS-820 PERFORMANCE SPECIFICATIONS

Frequency Range	160 meter band 1.8 to 2.0 MHz 80 meter band 3.5 to 4.0 MHz 40 meter band 7.0 to 7.3 MHz 20 meter band 14.0 to 14.35 MHz 15 meter band 21.0 to 21.45 MHz 10 meter band 28.0 to 28.5 MHz 28.5 to 29.0 MHz 29.0 to 29.5 MHz 29.5 to 29.7 MHz WWV ... 15.0 MHz (receive only) AUX band
Mode	CW, USB, LSB, FSK
RF Input Power	SSB: 200 Watts PEP SW: 160 Watts DC FSK: 100 Watts DC
Antenna Inpedance	50 to 75 ohms, unbalanced
Carrier Suppression	Better than 40 dB (Mod. freq. at 1.5 kHz)
Side-Band Suppression	Better than 50 dB (Mod. freq. at 1.5 kHz)
Microphone	High impedance (50 kΩ)
AF Response	400 to 2,600 Hz
Spurious Radiation	Harmonics Less than -40 dB Others Less than -60 dB
Receiving Sensitivity	S/N 10 dB or better at 0.25μV
Image Ratio	160 to 15 meter band: Better than 60 dB 10 meter band: Better than 50 dB
IF Rejection	Better than 80 dB
Frequency Stability	Within ±1 kHz during one hour after one minute of warm-up, and within 100 Hz during 30 minute period thereafter
Receiving Selectivity	SSB: 2.4 kHz (-6 dB) 4.4 kHz (-60 dB) CW: 0.5 kHz (-6 dB), with optional CW filter 1.5 kHz (-60 dB), with optional CW filter
AF Output Power	More than 1.5 watts (with less than 10% distortion) into an 8 ohms load
Audio Output Impedance	4 to 16 ohms (speaker or head phone)
Tube and Semi-conductors	3 tubes (2 × S2001A, 12BY7A) 5 ICs 30 FETs 74 transistors 165 diodes
Power Requirements	120/220VAC, 50/60Hz
Power Consumption	Transmit: 280 watts Receive: 26 watts (with heater-off)
Dimensions	13-1/8 (333) wide × 6-0 (153) high × 13-3/16 deep inch (mm)
Weight	35.2 lbs (16 kg)

*Specification and designs are subject to change without prior notice.

Circuit Design of the TS-820

1 Basic Design ..... Single Conversion System .....

The TS-820 uses the single conversion system with PLL type local oscillator. The IF frequency is set to 8.83MHz and the VFO covers 500kHz between 5.5MHz and 5.0MHz.

In conventional amateur band transceivers, the double conversion system is often used. This system features a fixed 1st local oscillator and a variable 2nd local oscillator, and is employed in the TS-520 and other models.

The double conversion system has the following merits and demerits:

- Easy multi-band operation by changing the 1st local oscillator frequency.
- Flexibility of setting the 1st IF frequency.
- Excessive mixer noise by converting the frequency two times.
- 2nd mixer is easily affected by a large input, requiring some proper measures to cope with the deterioration of two-signal characteristics.
- A large number of oscillator elements and mixer circuits are used, so beat interference and spurious signals are easily generated.

In contrast, the single conversion system has the following merits and demerits:

- 1-stage mixer circuit is used, so the mixer noise is substantially decreased.
- The number of oscillator elements is reduced, thus the possibility of beat interference and spurious signals are minimized.
- A complex local oscillator circuit is required for multi-band operation.
- IF frequency cannot be set too high because of the characteristics of the crystal filter.

The TS-820 employs the single conversion system to improve the two-signal characteristic during reception and the spurious characteristic during transmission. It also employs a PLL type local oscillator to solve the problems of multi-band operation and the complex local oscillator circuit. The use of the unique single conversion system and the PLL type local oscillator has materialized the single dial pointer reading and facilitated the IF shift.

2 Signal Route of TS-820

This section is intended to describe how the signal travels in the circuit. Fig. 5 shows the block diagram of the TS-820.

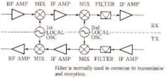


Fig. 1 Typical Double Conversion System

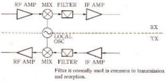


Fig. 2 Single Conversion System

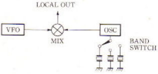


Fig. 3 Pre-mix Type

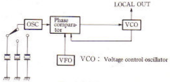


Fig. 4 PLL Type

	Mecha-nism	Frequency Stability	Spurious
VFO select type	Comples	Difficult throughout the entire band	Good
Pre-mix type	Simple	Good, same as VFO	Not very good
PLL type	Simple	Good, same as VFO	Good

Table 1 Types of Local Oscillators in Single Conversion System

The IF frequency of the TS-820 is set to 8.83MHz as noted previsouly. The 8-element crystal filter is used for SSB operation. The bandwidth of this filter is 2.4kHz/-6dB and 4.4kHz/—60dB, the guaranteed attenuation is less than —80dB, and the shape factor is 1.83. This filter is also used for CW operation when the CW crystal filter (optional) is not used. Like the TS-520, the TS-820 is fully transistorized, except for the transmit driver and final stages, and the major circuits employ dual gate MOS FETs to improve the two-signal characteristic to the level comparable with that of tubes.

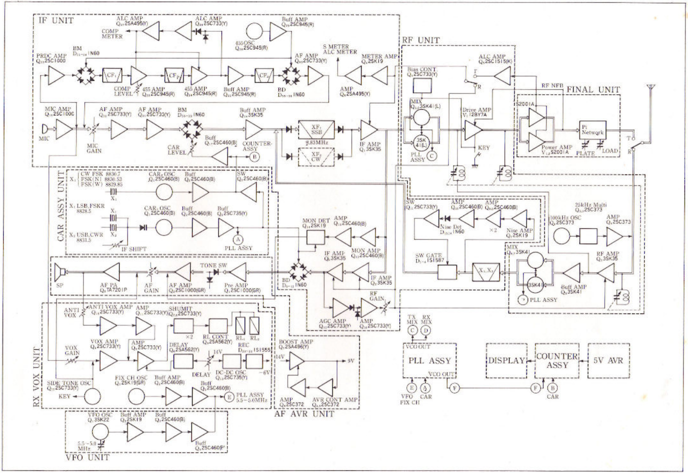


Fig. 5 TS-820 Black Diagram

Reception

The signal from the antenna is stepped up by the antenna coil and fed to the 1st gate, 3SK35, of the RF AMP where the signal is amplified by about 20dB. The amplified signal then passes through the impedance converter circuit, 3SK41, and balanced by the wide bandwidth transformer. The balanced signal is fed to the 1st gate of the balanced mixer (3SK41 x 2) where it is mixed with the PLL local oscillator signal (VCO output) which is converted into the IF signal. The mixer circuit is C divided except for the 28MHz band, to reduce the signal level and thus the two-signal characteristic in the 3.5MHz and 7MHz bands can be improved when strong interference is present. The IF signal is applied to the 8-element crystal filter via the 2-element crystal filter for the noise blanker and the gate circuit, amplified to about 90dB by the 3-stage IF AMP and is then demodulated into an AF signal by the ring detector. The demodulated signal is amplified by the AF AMP to drive the speaker.

The AGC signal taken from the 3rd IF AMP is rectified and amplified, and the AGC voltage thus obtained is applied to the RF AMP and IF AMP. The quick start amplification type AGC and the excellent AGC characteristic of the dual gate MOS FET offer outstanding dynamic range. Fig. 8 shows the level diagram of the receiver section.

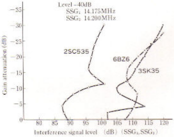


Fig. 6 Cross Modulation Characteristic

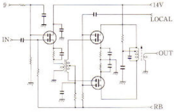


Fig. 7 Receiver Balanced Mixer Circuit

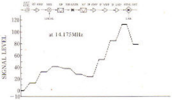


Fig. 8 Receiver Level Diagram

Transmission

The AF signal fed through MIC AMP to the balanced modulator is a DSB signal which is converted into an SSB signal after passing through the 8-element crystal filter common to the receiver section. The signal is fed to the double balanced mixer circuit (3SK41 x 2) via the IF AMP. This mixer circuit provides the spurious characteristic of less than −60dB which is usually found in VHF transceivers. Photos 1 shows the transmit output at center frequency of each band obtained by a spectrum analyzer.

The RF signal converted by the mixer into the wanted operating frequency is amplified by the driver, 12BY7A, and power amplified by the final tubes, S2001A × 2, so as to be applied to the antenna.

The monitor circuit is one of the major features of the TS-820. In this circuit, the SSB signal taken from the IF stage is demodulated to an AF signal by the product detector, 2SK19. This circuit functions during SSB operation.

As for the increase of talk power during SSB operation, the TS-520 is designed so that it can be increased by changing the operating condition of the ALC. In contrast with this, the TS-820 uses KENWOOD's unique RF speach processor in the MIC AMP unit. The compression level of the processor can be set freely by the level controller on the front panel and its operating conditions can be monitored by

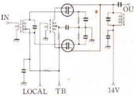
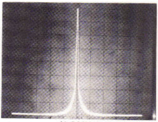
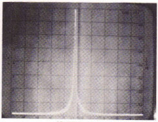
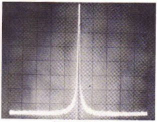


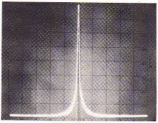
Fig. 9 Transmitter Balanced Mixer Circuit

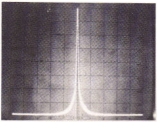
the meter. The adoption of the highly efficient amplification type ALC and RF NFB added in the final stage provide emission of high quality, splatterless powerful signals suitable for DX operation.


(1.9 MHz)


(3.75 MHz)


(7.15 MHz)


(14.175 MHz)


(21.225 MHz)

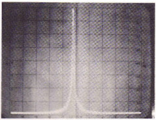

(28.8 MHz)

Photo 1 Spurious Radiation

Special Circuits of the TS-820

1 PLL

Today multi-band type VHF transcievers equipped with the PLL system are often used. In the case of HF band transceivers, the circuit configuration is different from that of VHF band tansceivers because of the wide frequency range and othe adoption of a VFO.

The newly developed PLL circuit used in the TS-820 is shown in Fig. 10, 11. The VCO signal is mixed with the HET signal to convert into the common signal of 3.33~3.83MHz and is then converted into 5.5~5.0Hz by mixing with the CAR signals to compare the phase with that of the VFO frequency of 5.5~5,0MHz. The comparison output is fed back to the VCO so that the VCO can be locked. HET MIX is used to set the frequency of each band to a fixed frequency, while CAR MIX is used to maintain the transmit/receive frequency unchanged even when the mode of operation is changed, by applying the CAR signal to the PLL loop; also, it is used to shift the IF frequency.

The HET and VCO each are provided with oscillator circuits for individual bands, which are electronically selected by the interlocking switch.

The CAR oscillator is divided into CAR1 and CAR2; the former is used for CW, USB, LSB and FSK (reception), and the latter for CW and FSK (transmission). Three cyrstals are used for 8828.5kHz, 8831.5kHz (CAR1) and 8330.7kHz (CAR2). Other frequencies are obtained by vari-caps.

The frequency applied to the PLL loop is taken from CAR1. In the case of CW or FSK transmission, a PLL loop is formed by CAR1 and the transmit carrier is taken from CAR2. The features of the PLL circuit are as follows:

- Since the frequency at which the phase is compared is as high as 5MHz or over, the response speed (locking time) is quick and C/N (carrier/noise) is improved. Note that a slow response speed will cause the inital voice to be clipped off when VOX is used for cross channel operation with a remote VFO

CAR FREQ.

MODE	FREQ. kHz	OSC
LSB	8828.5	CAR_1
USB	8831.5	〃
CW(T)	8830.7	CAR_2
CW(R)	8831.5	CAR_1
FSK(R)	8831.5	〃
FSKⓈ	8830.7	CAR_2
FSKⓂN	8830.53	〃
FSKⓂW	8829.85	〃

VCO, HET FREQ. (MHz)

BAND	VCO	HET
JJY/WWV	23.83～24.33	20.5
1.8	10.63～11.13	7.3
3.5	12.33～12.83	7.0
7	15.83～16.33	12.5
14	22.83～23.33	19.5
21	29.83～30.33	26.5
28	36.83～37.33	33.5
28.5	37.33～37.83	34.0
29	37.83～38.33	34.5
29.5	38.33～38.83	35.0
AUX		

Fig. 10 Frequency Construction

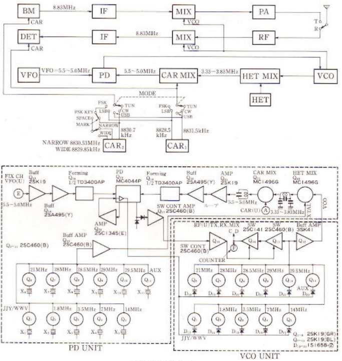


Fig. 11 PLL Block Diagram

or a fixed channel.

- Each band is provided with its own VCO to improve C/N of the oscillator.
- The VCO output is directely applied to the transmit/receive mixer, providing excellent spurious characteristic. This is one of the major features of the PLL system which is not found in the pre-mix system.
- An MC4044 is used for phase comparison to narrow the variable range of the VCO, thus preventing the VCO from being unlocked.
- The VFO is interchangeable with other TRIO-KENWOOD models. It is basically the same as conventional VFOs in operating principles so it can be used as a remote VFO without making any modifications.

2 IF SHIFT

The IF SHIFT is used to change the IF pass band without changing the receive frequency (carrier position). Turning the IF SHIFT knob will change the position of the IF filter as shown in Fig. 12. The IF SHIFT is not used very often because it requires a complex circuit. The TS-820 is equipped with a newly developed IF SHIFT circuit which is simple in configuration.

One of the IF SHIFT is achieved mechanically in such a manner that the IF frequency (2nd IF, 50kHz) is detuned by adjusting its core. This method is not utilized in the transceiver and receiver which use the crystal filter. An electrical method is normally used.

Fig. 13 shows the IF SHIFT circuit of the TS-820. Since the frequencies on both sides of PD (phase detector) are the same:

$$F\,VFO = F\,CAR - (F\,VCO - F\,HET)$$

$$\therefore F\,CAR = F\,VFO + F\,VCO - F\,HET$$

If F CAR is shifted by $\triangle f$ with F VFO and F HET unchanged:

$$F\,CAR \pm \triangle f = \{(F\,VFO - F\,HET) + F\,VCO\} \pm \triangle f = (F\,VFO - F\,HET) + (F\,VCO \pm \triangle f)$$

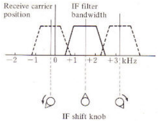


Fig. 12 IF SHIFT(USB)

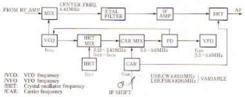


Fig. 13 IF Shift Construction

Therefore, if F CAR is changed by+ △f, F VCO also changes by +△f.
Since the receive frequency (carrier position) FR is:

FR = F VCO − F CAR

the receive frequency FR' obtained when F CAR is changed by + △f is as shown below.s,

FR' = (F VCO + △f) − (F CAR + △f)
= F VCO − F CAR
∴FR' = FR

However, the position of the IF band is:

FR = F VCO − frequency of X-tal filter

and therefore FR changes equivalently with the change in F VCO.

As described above, the IF SHIFT of the TS-820 is accomplished by changing the carrier frequency. Fig.14shows the carrier oscillator circuit. During reception a voltage is present on RLR, thus D4 is turned to ON and the voltage changed by the IF SHIFT VR is applied to the vari-cap D5 to change the frequency. During transmission a voltage is present on RLT, thus D4 is turned to OFF and the frequency remains unchanged regardless of the position of the IF SHIFT VR. The features of the IF SHIFT circuit are as follows:

- The IF SHIFT causes no changes in receive frequency.
- The IF SHIFT is processed by the local oscillator circuit and no adverse effect is given to the receive signal system.
- The frequency remains the same when the mode is changed to USB or LSB.

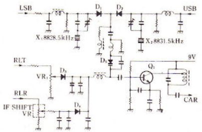


Fig. 14 Carrier Oscillator Circuit (IF Shift)

3 Speech Processor

These days, the method of processing voice signals is often talked about among hams. In general, the difference between the maximum voice amplitude and the average amplitude is about 15~20dB. During SSB operation, this difference appears directly in the transmit output.

One example in this case is that even a transceiver capable of 100W peak power delivers only 1~3W of average ouput. If such a transceiver has a margin in the capacity of the final tube and the power supply, the average transmit power can be increased for improvement of intelligibility by introducing a speech processor.

These are several types of speech processors, as follows:

AF Compressor System

When the voice signal exceeds a predetermined level, AGC voltage is generated to reduce the amplifier gain so that the peak of the voice signal is maintained at a fixed level.

This system requires a relatively large time constant to release the AGC circuit because of the distortion problem and therefore the average output cannot be increased as expected.

AF Clipper System

Voice signals above a predtermined level are clipped to suppress the amplitude and raise the average level. This system uses a non-linear circuit, producing higher harmonic distortion and cross modulation distortion which extremely deteriorates the tonal quality.

RF Clipper System

Voice signals are clipped after being converted into an SSB signal. This system, when used with a filter, eliminates harmonic distortion but does not eliminate the cross modulation distortion remained in

4 RF NFB

The TS-520 is well reputed for its sound quality. This has been attained by our careful design of the circuitry; for example, the distortion in the AF stage, frequency chracteristic, distortion in the RF stage, level distribution, ALC, etc. have been fully studied in consideration of overall balance of performance.
It is known that the distortion in the AF stage can be improved by adopting NFB (negative feedback) as is found in the TS-520. However, the distortion in the RF stage is hardly improved because of the difficulty of adopting NFB due to restrictions imposed on the arrangement of parts.
The TS-820 has solved this difficult problem for the first time to provide clearer and more intelligible sound.
The difficulty of adopting RF NFB lies in the oscillation due to phase variation in the NFB circuit. This variation can be minimized by taking the following measures:

- NFB circuit should be given a sufficient margin in design.
- The driver and final stages should be fully neutralized.

The above measures seem to be simple for materialization but involve very difficult problems when they are actually designed. The adoption of RF NFB also involves the problem of deterioration of selectivity.
Although a feedback amplifier broadens the audio frequency band, a tuned type amplifier tends to deteriorate the selectivity as shown in Fig. 17. For this reason, it is necessary to gain the selectivity before the driver stage if the transmitter is designed to improve the spurious characteristic by the selectivity of the driver stage and the final stage.

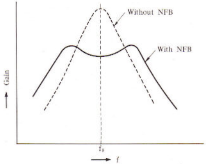


Fig. 17 Selectivity of tuned typed amplifiers

In the TS-820, the IF frequency is high, 8.83MHz, and a balanced type mixer is employed, so it is unnecessary to attenuate the nearby spurious signals at the driver and final stages; this makes it possible to apply NFB to the driver stage following the mixer circuit.
Photo 4 shows the output without NFB and Photo 5 shows the 2-tone output with NFB. The product of the 3rd cross modulation without NFB is −25dB and that with NFB is −35dB, showing an improvement by about 10dB. Also, the product of the 5th cross modulation without NFB is −33dB and that with NFB is −37dB, showing an improvement by about 4dB. Similarly, the product of the 7th cross modulation without NFB is −52dB and that with NFB is −58dB, showing an improvement by about 6dB.

Comparison with and without RF NFB
14.175MHz
Two (2) tone 1.0kHz 1.575kHz
Two (2) tone output 50W
B.W: 100Hz
S.W: 1kHz/Div.

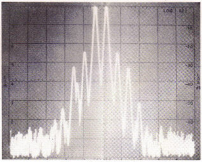


Photo 4 WITHOUT

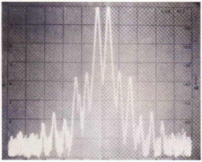


Photo 5 WITH

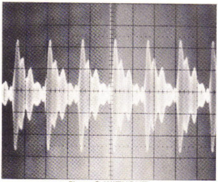


Photo 2 WITHOUT

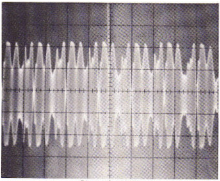


Photo 3 WITH

Comparison with and without RF Processor

pass band of the SSB filter. Voice signals are clipped by about 15dB and the average output is substantially increased, though distortion is noticeable.

The TS-820 uses the so called RF compressor system as shown in the block diagram of Fig. 15, instead of these 3 systems. In this system, voice signals are converted into an SSB signal at 455kHz. The signal thus converted is processed through the AGC amplifieer and the demodulator to raise the average level of the voice signal.

Since this system has no clipping circuit, it generates less distortion than the RF clipper system. Also, since the signal is RF processed, it is completely free from even cross modulation distortion which is normally generated in an AF compressor system.

The RF compressor system is capable of more than 50dB of compression which can be monitored by the meter. As the meter pointer has inertia, the meter scale is graduated up to 40dB. The compression level is adjustable by the knob on the front panel.

In using the RF processor, it is most important to reduce the background noise as much as possible and therefore a

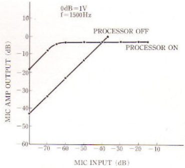


Fig. 16 INPUT/OUTPUT Curve

noiseless cooling fan is used in the TS-820.

It should be noted that the processor is not used during normal operation but is used only when the signal strength is weak so that the intelligibility of the signal can be improved.

It should also be noted that the increase in the average output naturally increases the anode input to the final tube. This reduces the life of a final tube such as a low power tube or a TV sweep tube.

The TS-820 uses S2001A for the final tube, thus the dependability is further enhanced.

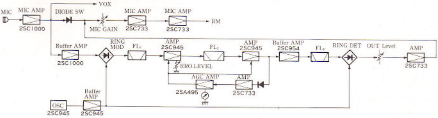


Fig. 15 Speech Processor Block Diagram

5 Digital Dial

The dial system of the TS-820 features analog and digital readings which are not found in conventional transceivers. This section is intended to describe the mechanism, functions and features of the digital dial system.

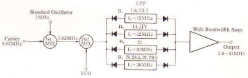
Features

- This dial indicates correct operating frequencies with accuracy up to the 100Hz order regardless of the positions of the knobs such as BAND, MODE, FUNCTION and RIT on the front panel. The accuracy of the counter unit is determined by the stability of the standard oscillator. DG-1 is provided with a crystal oscillator having aging characteristic of $\triangle f = 1 \times 10^{-6}$/month, thus guaranteeing the accuracy up to the 100Hz order.
- The dial system includes the DH (display hold) circuit. By turning the DH switch to ON, the frequency displayed on the dial remains unchanged to permit the operator to memorize the frequency.
- The mono-scale digital dial is small in size and features easy and fatigue-less operation. It uses blue fluourscent tubes to permit fatigue-less operation without affecting the eyes of the operator. The dial scale is graduated from MHz to 100Hz order in 5 to 6 digits.
- The digital dial is compact and easily installed by securing the counter unit, indicator unit and the power supply unit with screws and using the connector. No soldering is required.

Construction

Fig. 18, shows the block diagram of the digital dial. Besides indicating the frequency variation of the VFO, this dial also indicates frequency variations caused when MODE is changed from one operating mode to another, by synthesizing the VCO and carrier frequencies as shown in Fig. 19, thus actual operating frequencies can be read on the dial. The latch signal interval is set to 0.2 seconds for ease of reading and smooth function of the dial. In this way, the frequency memorized in the latch circuit is displayed every 0.2 seconds. If this time interval is shortened, the indication flickers quickly causing the frequency hard to be read; if it is lengthened, the frequency will not follow the dial operation.

The DH (display hold) circuit holds frequencies indicated when the latch signal is OFF. During the operation of the DH circuit, the frequency of MHz order disappears while the frequency of 4 digits is memorized on the dial.



BAND(MHz)	VCO Freq. (MHz)	Output Freq.(MHz)	LPF BAND
1.8	10.63−11.13	2.8− 3.3	
3.5	12.33−12.83	4.5− 5.0	B1
7	15.83−16.33	8.0− 8.5	
14	22.83−23.33	15.0−15.5	B2
JJY(15)	23.83−24.33	16.0−16.5	
21	29.83−30.33	22.0−22.5	B3
28	36.83−37.33	29.0−29.5	
28.5	37.33−37.83	29.5−30.0	B4
29	37.83−38.33	30.0−30.5	
29.5	38.33−38.83	30.5−31.0	

Fig. 19 DG-1 Frequency Construction

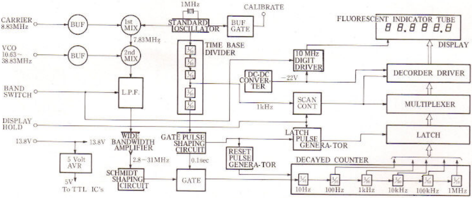


Fig. 18 DG-1 Block Diagram

System Design of the TS-820

The TS-820 is equipped with its own power supply and speaker, as well as a rigid chassis. The appearance and the internal design are similar to those of the TS-520; for example, the power supply unit, the final unit and the VFO unit are mounted almost in the same manner and wired through connectors in consideration of the productivity and serviceability.

Front Panel

The knob arrangement is also similar to that of the TS-520. All knobs are designed on the basis of human engineering technology for easy operation. The dial panel is designed with white letters on a black background to match the digital display tubes. It is also provided with an illumination lamp.

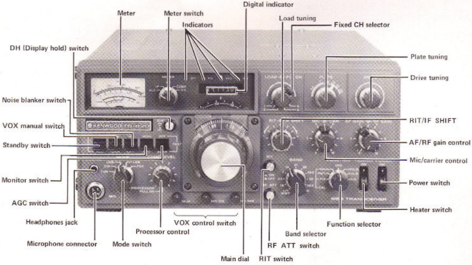
Both the front panel and the dial escutcheon are die cast as are found in the TS-520 and TS-700A(G).

Dial Mechanism

The TS-820 uses the so called mono-scale system in the dial mechanism. The same system is used in the TS-900 except for the drive system; the dial of the TS-820 is driven by a ball drive mechanism as found in the TS-520, while that of the TS-900 is driven by a gear drive mechanism. The ball drive mechanism used in the TS-820 is a newly developed mechanism.

This new dial is simple in construction with only 9 gears including a double gear, and is very compact in styling. It offers the ultimate in economy and reliability. The major features of this dial are as follows:

- The differential gear unit and the vernier unit of the dial scale are independent of each other, and the dial has a self-contained calibrating unit.
- The sub-dial panel can be mounted.
- Compact design and interchangeability with the TS-520.
- The main parts are common with those of the TS-520, providing high reliability.



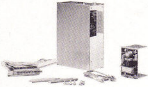
Related Devices and Optional Accessories

The following related devices and optional accessories are avaiable for more advanced operation of the TS-820.

Remote VFO VFO-820

The VFO is equipped with a DRS Dial of the same design as the TS-820 for excellent linearity, stability and ease in frequency reading. The Digital Display of the main unit also indicates frequency of the remote VFO.

Frequency Range: 5.0 to 5.5 MHz
Frequency Stability: 100 Hz per 30 minutes after warm-up
Semiconductor: 2 FETs, 2 Transistors, 7 Diodes



Digital Display DG-1

The digital display indicates accurate operating frequencies. It can be easily connected to the TS-820. No soldering is required.

CW Crystal Filter YG-88C

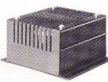
New and compact crystal filter with excellent shape factor to provide maximum performance during CW operation.

Bandwidth:0.5KHz/−6dB 1.8KHz/−6db 1.8KHz/−6dB
Guaranteed attenuation: Less than −80dB

External Speaker SP-520

This speaker is designed to match both the TS-820 and the TS-520 in styling, dimensions and tonal quality.

Impedance: 8Ω



DC-DC Converter DS-1

This is used to power the TS-820 with a car battery during mobile operation.

2 Meter Transverter TV-502

The TV-502 is an all solid state 2 meter band transverter. The excellent performance of the TS-820 can be enjoyed on the 2 meter band by simply connecting it to the TS-820 with cables supplied.

Frequency Range: 144 to 146.00 MHz
RF Input: 16 watts
Semiconductor: 5 FETs, 15 Transistor, 10 Diodes

Desk-top Dynamic Microphone MC-50

Uni-directional microphone exclusively designed for transceivers. It is equipped with a lock type PTT switch. The output impedance is switchable between 50KΩ and 600Ω.

Communications Headphones HS-4

A dynamic type, high intelligibility headphone which is functionally designed to permit extended hours of fatigue-less operation.

Impedance: 8Ω

All of the above items are available from your authorized Trio-Kenwood dealer and carry the normal Trio-Kenwood 90 day limited warranty.

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KENWOOD

Dear TS-820 Owner:

By now you have probably experienced several hours of enjoyable QSOs with your new Kenwood TS-820. As a proud owner of the most popular transceiver on the HF bands today, we are certain that you would like to know as much as possible about the circuitry in the TS-820 as well as the history and development of its overall design.

Trio-Kenwood proudly sends this new booklet of TS-820 technical information to you in hopes that you will enjoy reading more about your new Kenwood TS-820 transceiver.

Best 73,

TRIO-KENWOOD COMMUNICATIONS, INC.

BC/adr