KENWOOD

COMMUNICATIONS RECEIVER R-820

THE HIGHLY SOPHISTICATED, ULTIMATE R-820 RECEIVER F

The R-820 receiver combines more features than any other HF ham-band receiver.
Backed by KENWOOD's advanced know-how in high-frequency technology, the TS-820 SSB transceiver series offers outstanding performance, high reliability, and many useful features, as well as exceptionally high price/performance. It has been regarded, since the day it hit the market, as one of the most advanced HF SSB transceivers in the world.
Utilizing the best circuit-design features of the TS-820, other features have also been incorporated to deal with any HF receiving condition in the Model R-820 HF receiver.
Designed for transceive operation with the TS-820, the R-820 has a tuning range covering the entire HF amateur bands (1.8 to 29.7 MHz) in AM, CW, SSB, and RTTY modes, as well as JJY/WWV bands, plus four short-wave broadcast bands.

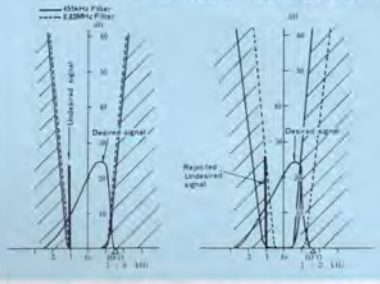
Maximum receiver performance and capabilities for every condition of HF operation have been designed into the R-820.

For highest receiver performance, features include double-tuned RF stages, balanced FET mixers, MOS FETs in many RF and IF stages, optimum signal level distribution, and a 455 kHz IF filter.
Results throughout the entire tuning range from the lowest to the highest frequency bands include excellent signal-to-noise ratio, sensitivity, stability, image ratio, spurious responses, etc., particularly in characteristics such as intermodulation and blocking.
In detecting the desired signal while eliminating adjacent unwanted signals, it features, in addition to the IF shift circuit a feature made famous with the TS-820, a tunable IF filter (or VBT for variable bandwidth tuning) and an IF notch circuit, a unique combination which will reject a signal differing only very slightly in frequency from the desired signal.
Furthermore, provisions for extra IF filters, variable audio frequency response, and noise-blanker threshold level settings are included as expandable features for more satisfactory HF operation.
The circuit configuration of the R-820 takes advantage of the PLL (phase-locked loop) single conversion developed for the TS-820, while narrowing the first IF bandwidth of 8.83 MHz (IF filters) to achieve improved intermodulation and blocking characteristics and, further, designing the receiver as a triple-conversion type with a 455 kHz 2nd IF and a 50 kHz 3rd IF.
Selection of 455 kHz for the 2nd IF has made possible independent IF shift and variable bandwidth tuning filter, plus improved IF filter responses.
Introducing a 50 kHz 3rd IF has allowed an even sharper notch response. The notch point is unaffected by these IF features.

A variable bandwidth IF filter (VBT) is incorporated.

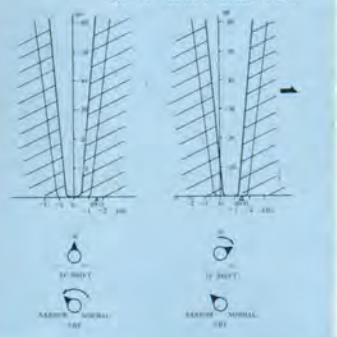
With the inclusion of the VBT (variable bandwidth tuning) circuit capable of varying continuously the IF filter passband width, optimum IF bandwidth may be established relative to varying conditions of interference.
Passband shift (actually of the center frequency) by an IF shift and VBT are independently adjustable. Therefore, it is possible to change only the IF passband width while the center frequency of the IF passband remains unchanged, or, while maintaining the passband width established by VBT, shift the passband (center frequency) of the filter to an optimum point with the IF shift.
Combined application with an IF notch may also be used.
(See Figs. 1 and 4.)

Fig.1 How VBT(Variable bandwidth tuning)work



- Passbands of both the 8.83-MHz and 455-kHz IF filters are made to intersect, in an equivalent sense, to obtain a narrow-bandwidth filter response. See how the unwanted signal is rejected from the passband thus obtained.
- In cases where interference from adjacent signals isn't too serious, signal-to-noise ratio may be improved by narrowing proportionally the IF passband width, as the noise content theoretically varies with bandwidth.
- The variable bandwidth tuning (VBT) filter circuit in the R-820 is so designed that the center frequency of the passband may be set to the desired point (by adjusting or by an IF shift), irrespective of the amount of bandwidth changed.

Fig.4 Combined activation of IF shift and VBT



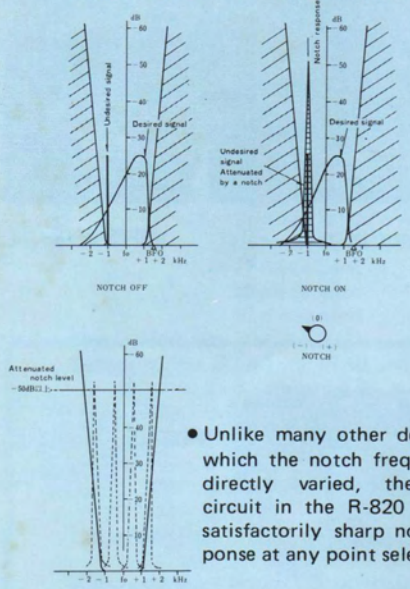
- Since the variable bandwidth tuning filter (VBT) and IF shift are separately adjustable in the R-820, a highly sophisticated unwanted signal rejection technique may be employed: first an appropriate bandwidth is selected by the variable bandwidth tuning and then an optimum tuning point is determined by means of an IF shift.
It is particularly effective in CW and RTTY when, by narrowing passband width by means of the VBT, the center frequency of the passband is aligned to the frequency of the desired signal by an IF shift.
- It is of course possible to fix the center frequency of the passband established by IF shifting and, according to the interference condition at the moment, the passband width is further altered by means of the VBT.

Included is a true 50-kHz notch circuit that provides a very sharp notch response.

By changing the BFO frequency and the local-oscillator frequency of the mixer in the preceeding stage simultaneously with a 50-kHz notch frequency (fixed), equivalent notch-frequency variation is obtained, similar to that of an IF shift.
Due to this circuit design, a consistent sharp notch response (attenuation 50-dB or greater) is achieved irrespective of the notch point within the passband, dissimilar to many other designs in which the notch frequency is made directly adjustable.
Moreover, since the notch circuit is located outside the IF shift loop, the notch point always remains constant whether or not the IF shift is used. (See Figs. 2 and 5.)

UNCTIONALLY MATCHED TO ITS COMPANION TS-820 TRANSCEIVER

Fig.2 How the IF notch works



- Unlike many other designs in which the notch frequency is directly varied, the notch circuit in the R-820 offers a satisfactorily sharp notch response at any point selected.

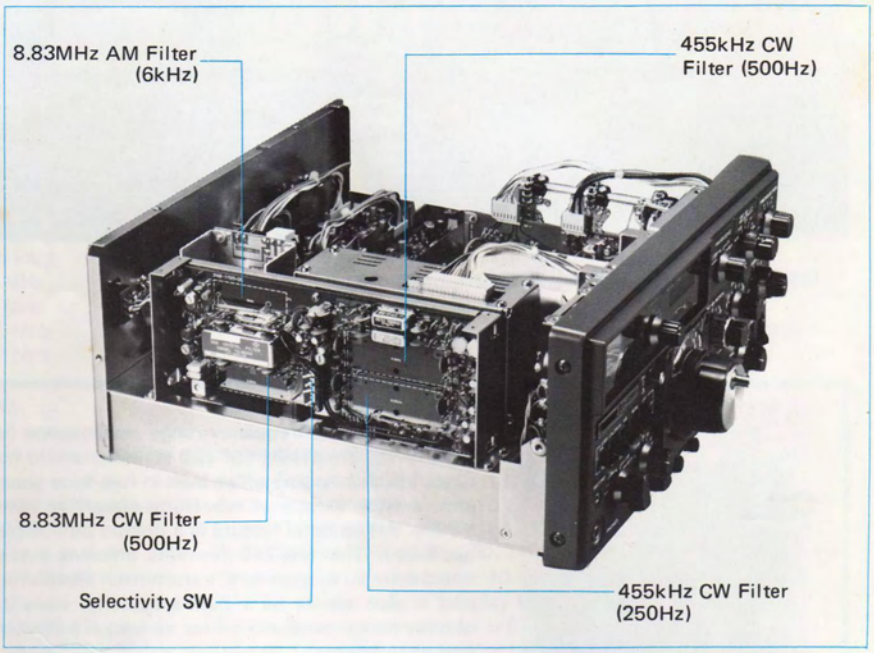
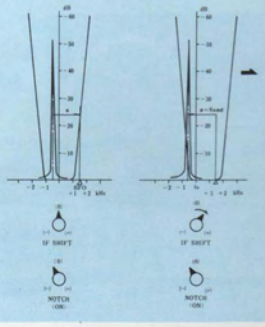
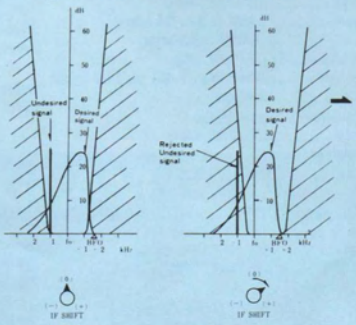


Fig.5 Combined activation of IF shift and notch



- Because the notch circuit in the R-820 is outside the IF shift loops, the notch point remains unchanged while turning the IF shift knob, and these controls are independently adjustable.
- As shown in the diagram, the interval "a" between the BFO and the notch point is maintained constant irrespective of the IF shift knob position.

Fig.3 How an IF shift works



- Shown here is an undesired signal being rejected by upshifting (+) the IF passband. Elimination of undesired signals by an IF shift is simple in operation.
- In CW, coupled with RIT, a variable pitch is obtainable; in SSB, the signal may be tuned to suit your requirement.

The IF shift circuit is a uniquely useful feature to reject unwanted signals while allowing frequency response of CW pitch to be varied.

The variable bandwidth tuning (VBT) and notch circuits, when combined with the IF shift, provides higher adjacent-channel selectivity, very useful under crowded conditions.

The IF shift circuit is capable of shifting the IF passband toward highter (+) or lower (−) frequencies with the tuned receiver frequency totally unchanged. Hence, an unwanted signal, if present in the IF passband, may be attenuated significantly by shifting the passband in either direction.

Making use of its high or low cutoff passband response in SSB, the desired signal may be adjusted to the desired tone pitch. In CW, likewise, its pitch may be varied by means of a combination of the IF shift and RIT. (See Figs. 3, 4 and 5.)

A Built-in feature enables transceive operation with the TS-820.

Coupling the TS-820 to the R-820's transceive connections permits a correlated operation of the VFO. Full use can be made of the TS-820's capabilities in its transmit and receive sections, in a combined operation with the R-820.

In the full transceive mode, a still more flexible operation may be attained by extracting a HET signal from the TS-820.

The RF-stage circuit design and double-tuned circuitry have resulted in improved selectivity, especially with respect to intermodulation and blocking.

Careful selection of front-end circuit elements and optimum signal level distribution in overall circuit design are among the important considerations involved in obtaining higher selectivity characteristics such as intermodulation and blocking.

The double-tuned circuitry in the RF stage also contributes to a sharper RF-stage selectivity.

An IF rejection of 90-dB and an image rejection of 80-dB, or better, have been attained (slightly less on shortwave broadcast bands).

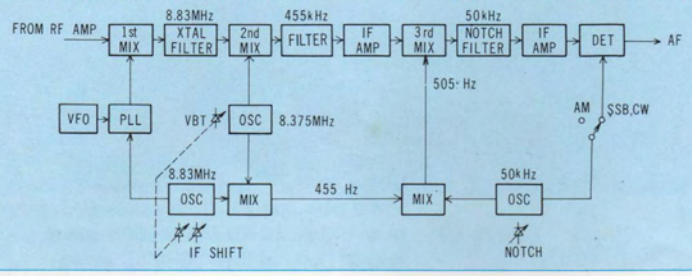
A wide choice of IF filter options are available.

Offered as optional filters are an 8.83-MHz CW filter (YG-88C), AM filter (YG-88A), and CW filters (YG-455C with passband width of 500-Hz and YG-455CN with passband width of 250-Hz) which are characterized by an exceptional shape factor and guaranteed attenuation. You can choose the filter, according to the mode selected and current signal condition, that best suits your particular requirement.

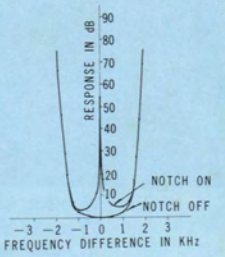
Each filter provices, either by automatic changeover (AUTO) with a mode switch or by an independent filter selector switch, a choice of 0.25-kHz, 0.5-kHz, 2.4-kHz, and 6-kHz bandwidths.

FOR SATISFACTORY AMATEUR STATION OPERATION

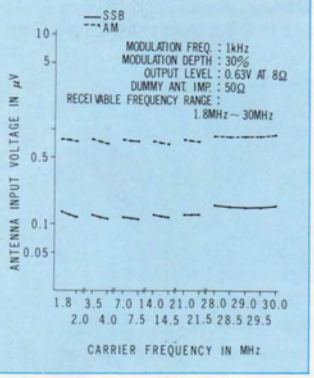
R-820 Variable Bandwidth, IF Shift, T Notch Filter Circuit Diagram.



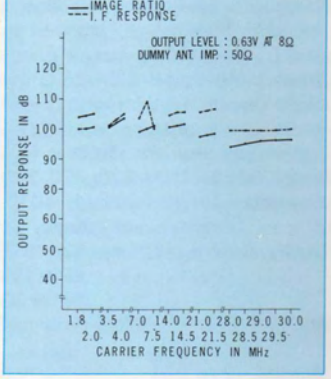
T notch Filter Response



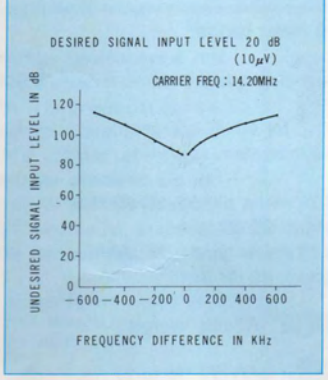
Usable Sensitivity Response



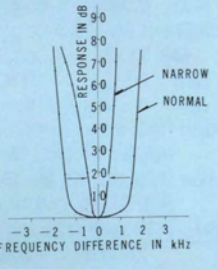
Spurious Response



2 Signal (Blocking) Response



Variable Bandwidth Response of SSB Filter



Of course, it is also possible, by combining different 8.83-MHz and 455-kHz filters, to obtain respective variable bandwidth characteristics. Desired combinations can be preset with internal selector switches.

A digital display indicates true frequency readings.

A digital readout display which operates on the synthesizer principle (synthesizing a readout from all local-oscillator frequencies) is incorporated.

Differing from simple VFO frequency conversion, exact frequencies are read to the order of 100 Hz in every band and mode.

The readout fluorescent tubes illuminate in green for easy viewing over an extended period of time.

The included shortwave broadcast bands also are indicated in exact frequencies, including the MHz reading, to the order of 100 Hz.

A monoscale dial is used in combination with a subdial for maximum maneuverability.

Tuning is easy, with a combination of the digital display, monoscale dial, and subdial (same as the TS-820S).

A combination of analog and digital elements allows the operator to appreciate ease of reading and comfort of dial tuning, from major frequency changes to the most minute.

A 0-to-40-dB RF attenuator variable in 10-dB steps is built in.

A provision is made in the R-820 for accepting strong incoming signals. A variable RF attenuator provides 0, 10, 20, 30, and 40-dB losses in increments of 10-dB.

Problems associated with strong incoming signals, particularly night-time broadcast stations and local stations, are no longer troublesome.

The "S" meter is calibrated to read in dB and μV.

Besides accurate "S" readings derived from a threshold-type RF gain control circuitry, the "S" meter also has dB/μV scales. This provision enables the operator to determine widely varying field-intensity measurements, from very strong to weak signals, coupled with the 0-to-40-dB RF attenuator.

Noise-blanker level and audio frequency response are adjustable.

The noise-blanker circuit is of a balanced-gate type, proven for its outstanding performance in the TS-820 and TS-520. In the R-820, the threshold level of the noise amplifier is adjustable with a front-panel control so that further improvement may be experienced in cases where the noise level is low and the noise blanker is near its critical point.

Transmit signal quality is easily monitored.

When using your transmitter (such as the TS-820), the sound quality of your signal past the final power stage and the presence of splatter can be monitored with the R-820 (when tuned frequency of the receiver is varied). Monitor level is adjustable with a front-panel control.

Four shortwave broadcast bands and AM IF filter are included.

Four shortwave broadcast bands primarily intended for receiving the 49-, 31-, 25-, and 16-meter bands are incorporated for shortwave broadcast and international communications reception.

You can also listen to broadcast stations in the 75-, 41-, 19-, and 13-meter (in part) bands.

The receiver may also be utilized for monitoring for specific stations to come on the air. It has a built-in 455-kHz filter dedicated for AM reception, and an optional 8.83-MHz AM filter (YG-88A) may be added within the receiver.

A wide variety of accessory capabilities and connection terminals are available.

The R-820 offers many additional capabilities and connecting terminals: a 25-kHz marker circuit, display hold switch, transceive/separate selector switch, full transceive/VFO transceive selector switch, standby switch, FIX channel/4-channel selector, indicators (NOTCH, FIX, VFO, and RIT), RTTY, SSTV connection terminals, IF OUTPUT terminals [two terminals for IF waveform observation (50-kHz) and for coupling a pan display monitor such as the SM-220 Station Monitor (8.83-MHz)], 13.8-VDC receptacle (the receiver can operate on a DC power source), and recording terminals.

R-820 SPECIFICATIONS

Tuning Ranges:

160-meter band	1.8～2.0 MHz
80-meter band	3.5～4.0 MHz
40-meter band	7.0～7.5 MHz
20-meter band	14.0～14.5 MHz
15-meter band	21.0～21.5 MHz
10-meter band A	28.0～28.5 MHz
10-meter band B	28.5～29.0 MHz
10-meter band C	29.0～29.5 MHz
10-meter band D	29.5～30.0 MHz
19-meter band (WWV)	15.0～15.5 MHz
49-meter band	5.9～6.4 MHz
31-meter band	9.4～9.9 MHz
25-meter band	11.5～12.0 MHz
16-meter band	17.7～18.2 MHz

Modes: SSB, CW, AM, and RTTY

Sensitivity (160, 80, 40, 20, 15, 10, and 19 meter bands):
for 10 dB minimum
SSB 0.25 μV S+N/N for 10 dB minimum
AM 1.5 μV S+N/N
(49, 31, 25, and 16 meter bands): for 10 dB minimum
SSB 0.5 μV S+N/N for 10 dB minimum
AM 3 μV S+N/N

Image Ratio (160, 80, 40, 20, 15, 10, and 19 meter bands): 80 dB min.
(49, 31, 25, and 16 meter bands): 50 dB min.

IF Rejection (160, 80, 40, 20, 15, 10, and 19 meter bands): 90 dB min.
(49, 31, 25, and 16 meter bands): 40 dB min.

Selectivity (CW with 0.25 kHz filter):
250 Hz (at —6 dB), 500 Hz (at —60 dB) *Note 1
(CW with 0.5 kHz filter):
500 Hz (at —6 dB), 850 Hz (at —60 dB) *Note 2
(SSB with 2.5 kHz filter):
2.4 kHz (at —6 dB), 3.9 kHz (at —60 dB)
(AM with 6 kHz filter):
6 kHz (at —6 dB), 12 kHz (at —60 dB)

Variable Bandwidths
(CW with 0.5 kHz filter):
150～500 Hz (—6 dB) continuously variable *Note 3
(SSB with 2.4 kHz filter):
600～2.4 kHz (—6 dB) continuously variable *Note 4
(AM with 6 kHz filter):
4.3 kHz～6kHz (—6 dB) continuously variable
Note 1: Optional filter YG-455CN added
Note 2: Optional filter YG-455C added
Note 3: Optional filters YG-88C and YG-455C added
Note 4: Optional filter YG-88A added

Notch Filter Attenuation: 50 dB or greater

Frequency Stability: ±1 kHz max. from 1 to 60 minutes after power on
±100 Hz max. in every subsequent 30 minutes

Antenna Impedance: 50～75 Ω (unbalanced)

Audio Output: 1.5 W min. (8 Ω load, 10% distortion)

Audio Load Impedance: 4～16 Ω, both speaker or headset

Power Consumption: 30 W at 13.8 VDC, 1.6 A

Power Source: 100, 120, 220, 240 VAC, 50/60 Hz or 12～15 VDC

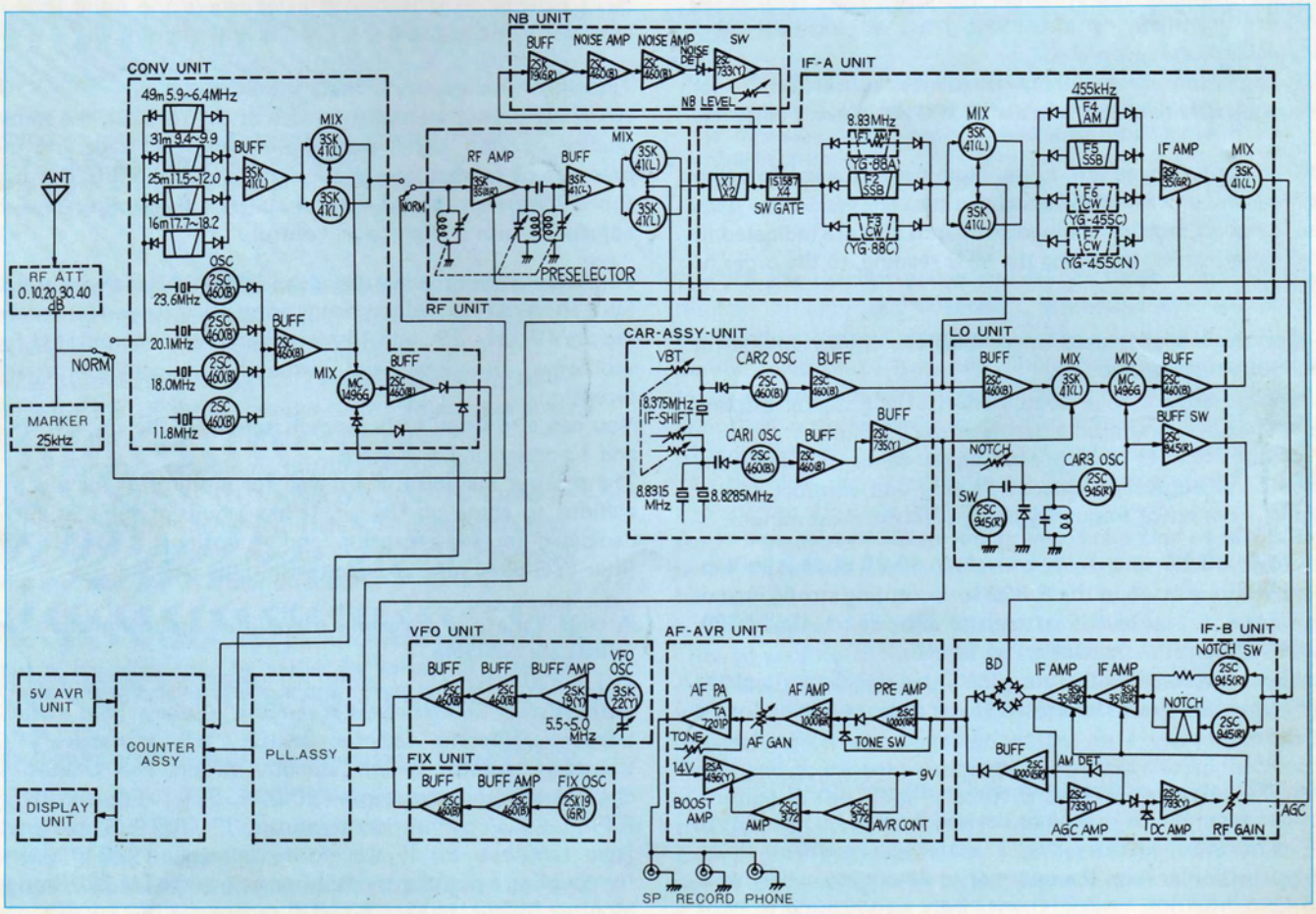
Transistors and Diodes Used: 40 ICs, 34 FETs, 89 transistors, 170 diodes, and 1 display tube

Outline Dimensions (mm): 13-1/8" or 333 (336) mm wide
6" or 153 (167) mm high
14" or 335 (397) mm deep

NOTE: Figures in brackets show maximum dimensions including protrusions.

Weight: 12 kg

R-820 BLOCK DIAGRAM



SP-820 SM-220 R-820 TS-820S VFO-820

SM-220

Based on a wide-frequency-range oscilloscope (up to 10 MHz), the Model SM-220 station monitor features, in combination with a built-in two-tone generator, a wide variety of waveform-observing capabilities. An optional feature is a unique pan-display capability. 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.

CRT 76ARB31

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 ..... More 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 k-ohm (at TWO TONE)

Pan Display Unit
Adaptor name..... BS-5 (TS-520 series)
BS-8 (TS-820 series)
Input center frequency ... 3.395 MHz (BS-5)
8.830 MHz (BS-8)
IF frequency..... 455 kHz
IF bandwidth ..... More than 1 kHz (−6 dB)
Input sensitivity ..... More than 10 μV/div.
Scan width ..... ±20 kHz, ±100 kHz, switchable gain

Horizontal Amplifier
Deflection sensitivity ..... More than 300 mV/div.
Frequency response ..... DC-250 kHz or over (EXT GAIN at MAX)
DC-40 kHz (EXT GAIN at 1/2)
Input resistance/capacitance ..... 1 M-ohm (±20%)/35 pF
or less (SYNC switch at INT)
Attenuator ..... Fully variable to 0
Max. input voltage ..... 100 Vp-p

Sweep Circuit
Sweep frequency ..... 10 Hz～100 kHz (4 ranges, with fine adjustment)
Sweep linearity ..... Better than 5%
Sync system ..... Synchronized sweep, internal negative sync and external sync
Sync amplitude ..... Internal: More than 1 div. on CRT
External: More than 2 Vp-p

Vertical Amplifier
Deflection sensitivity ..... More than 20 mV/div.
Frequency response ..... 2 Hz～10 MHz (−3 dB)
Input resistance/capacitance ..... 1 M-ohm/40 pF
Overshoot..... Less than 5%
Attenuator ..... 1, 1/10, 1/100 and GND/MONITOR (Error between steps: 5% max.)
Max. input voltage ..... 300 V (DC+AC peak) or 600 Vp-p

Power Supply ..... 100 V, 120 V, 220 V, 240 V AC ±10%, 50/60 Hz 20 W (Power supply may change according to destination)

Dimensions ..... 215 (8-1/2) W×153 (6-1/4) H×335 (13-3/16) D mm (inch)

Weight..... 5 kg (11 lbs.)

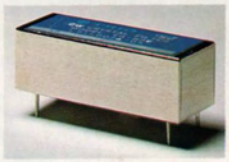
SP-820

The SP-820 has built-in selectable tone filters to attenuate high and/or low frequencies. You can switch between two different receiver sources. Headphones may also be used in conjunction with the filter network.

Speaker Diameter . . . . . .12 cm (4-3/4")
Max. Input power. . . . . .2 watts
Input Impedance . . . . . .8 ohms
Frequency Response . . . . . .100 Hz to 5 kHz
Dimensions . . . . . .169 (6-1/4)W x 153(6)H x 335 (13-3/16)D mm (inch)
Weight . . . . . .2.5 kg (5.5 lbs)

HS-5

HS-4



YG-88C
YG-88A

YG-455C
YG-455CN

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