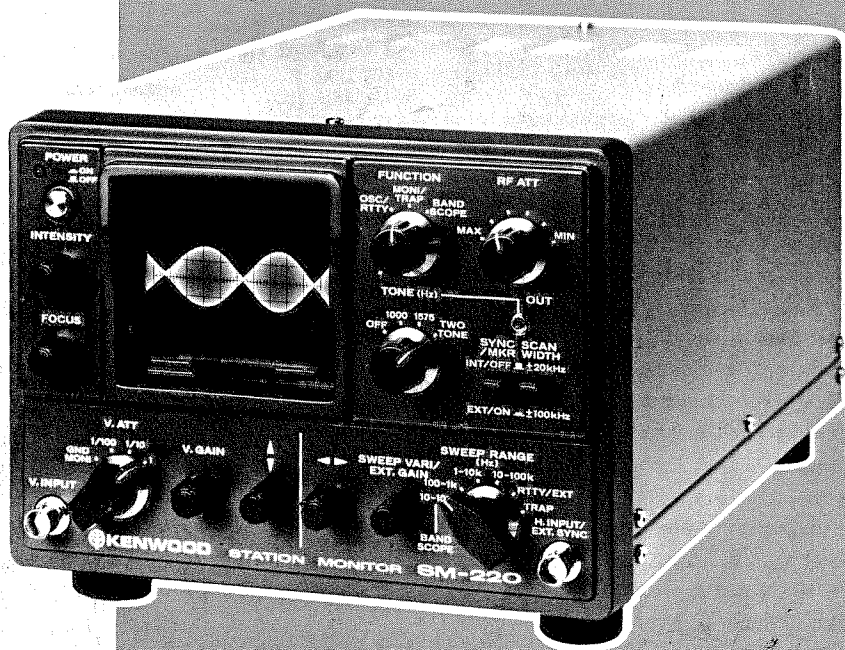




## STATION MONITOR

# Model SM-220



OPERATING MANUAL

## AFTER UNPACKING

**Shipping Container:**

Save the boxes and packing in the event your unit needs to be transported for remote operation, maintenance, or service.

The following explicit definitions apply in this manual:

**NOTE:** If disregarded, inconvenience only - No risk of equipment damage or personal injury.

**CAUTION:** Equipment damage may occur, but not personal injury.

**WARNING:** Personal injury may occur - DO NOT DISREGARD!

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## SECTION 1. SPECIFICATIONS

### CRT 75ARB31

Phosphor ..... B31  
 Colour ..... Blue - Green

### TRANSMIT SIGNAL MONITOR TERMINAL

Frequency range ..... 1.8 ~ 150 MHz  
 Maximum power ..... 1.8 ~ 54 MHz 2 kW/PEP (Continuous for 5 minutes at RF ATT. MAX)  
 150 MHz (100 w/PEP)

SWR ..... 1.2 or less  
 Insertion loss ..... Less than 0.9 dB (at only 144 MHz)  
 Deflection sensitivity ..... More than 1 DIV at 2 W/PEP input  
 Attenuator ..... 6 steps

### TRAPEZOID WAVEFORM OBSERVATION

Frequency range ..... 1.8 ~ 30 MHz  
 Maximum power at DRIVE terminal ..... 100 W/PEP  
 SWR ..... 1.2 or less

### TWO-TONE GENERATOR

Oscillator frequency ..... 1,000 Hz, 1,575 Hz, or both, switchable  
 Output voltage ..... 5 mV/50 k $\Omega$  (at TWO TONE)

### PAN DISPLAY

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 20 dB  $\mu$ /DIV  
 Scan width .....  $\pm 20$  kHz,  $\pm 100$  kHz, selectable

### HORIZONTAL AMPLIFIER

Gain adjustment ..... 10 dB (Approximate)  
 Deflection sensitivity ..... More than 300 mV/DIV  
 Frequency response ..... DC-250 kHz or greater (EXT GAIN at MAX)  
 DC-40 kHz (EXT GAIN at 1/2)  
 Input resistance/capacity ..... 1 M $\Omega$  ( $\pm 20\%$ ), 40 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 (in 4 ranges, variable)  
 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/capacity ..... 1 M $\Omega$ , 40 pF  
 Overshoot ..... Less than 5%  
 Attenuator ..... 1, 1/10, 1/100 and GND/MONITOR  
 (Error between steps: 5% max.)  
 Max. input voltage ..... 300V (DC + AC peak) or 600 Vp-p

**POWER SUPPLY** ..... AC117V  $\pm 10\%$ , 50/60 Hz, 20W

**DIMENSIONS** ..... 215(W)  $\times$  153(H)  $\times$  335(D) mm

Weight ..... 5 kg

### ACCESSORIES SUPPLIED

Instruction book ..... 1  
 UHF type cable ..... 1  
 Tone generator output cable ..... 1  
 Auxiliary feet (with screws) ..... 2  
 Power cable (fitted to unit) ..... 1  
 Spare fuse ..... 1

Specifications are subject to change without notice due to technical improvement.

## SECTION 2. INTRODUCTION AND FEATURES

You are the owner of our new product, the Model SM-220 Station Monitor Scope. This unit has been carefully engineered and manufactured under rigid quality standards and should give you satisfactory and dependable operation for many years. Should any trouble arise with this unit, please contact your dealer, the nearest KENWOOD Service Facility, or the Factory.

1. Station Monitor SM-220 is designed specifically for measurement of the TS-820 and TS-520 series SSB transceivers.
2. The unit is comprised of a monitor-scope, oscilloscope and two-tone audio generator. A Pan Display option is also available.
3. The monitor-scope will display transmitted waveform from 1.8 MHz to 54 MHz, 5W-2 KW PEP, and to 150 MHz, 100W PEP. Drive input terminals permit trapezoid waveform observation.
4. The oscilloscope features high sensitivity (better than 20 mV/DIV) and wide bandwidth (2 Hz ~ 10 MHz), and makes possible measurement of various waveform types. Receiver IF can be displayed directly from the TS-820S IF-OUTPUT terminal.
5. The two-tone audio generator provides 1000 Hz and 1575 Hz tone individually or simultaneously.
6. A plug-in Pan Display is available as an option: For the TS-820S, specify the BS-8, or for the TS-520S specify the BS-5.
7. Horizontal trace tilt can be adjusted from the rear of the unit without removing the case.
8. The blue-green (B-31) phosphor CRT assures excellent brightness and contrast for extended fatigue free viewing.

# SECTION 3. CABLING REQUIREMENTS AND PRELIMINARY INSTRUCTIONS

## 3.1 CONNECTING CABLE I

### Output waveform:

When used in combination with the TS-820S, TS-520S or other transceivers, prepare one connecting cable (referring to Fig. 3-1).

### Trapezoid waveform:

When observing trapezoid waveforms of the TL-922 or other power amplifier, three connecting cables are required.

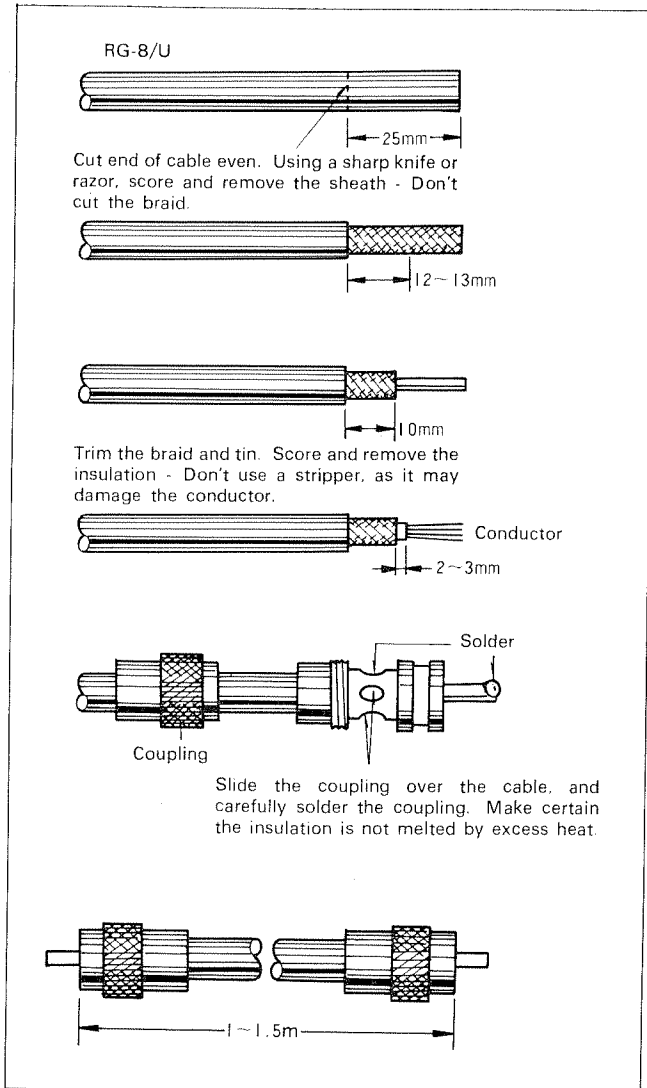


Fig. 3-1 Assembled UHF connector cable

## 3.2 CONNECTING CABLE II

When used as an oscilloscope, prepare one connecting cable (referring to Fig. 3-2).

When observing RTTY tuning cross patterns, two cables are required.

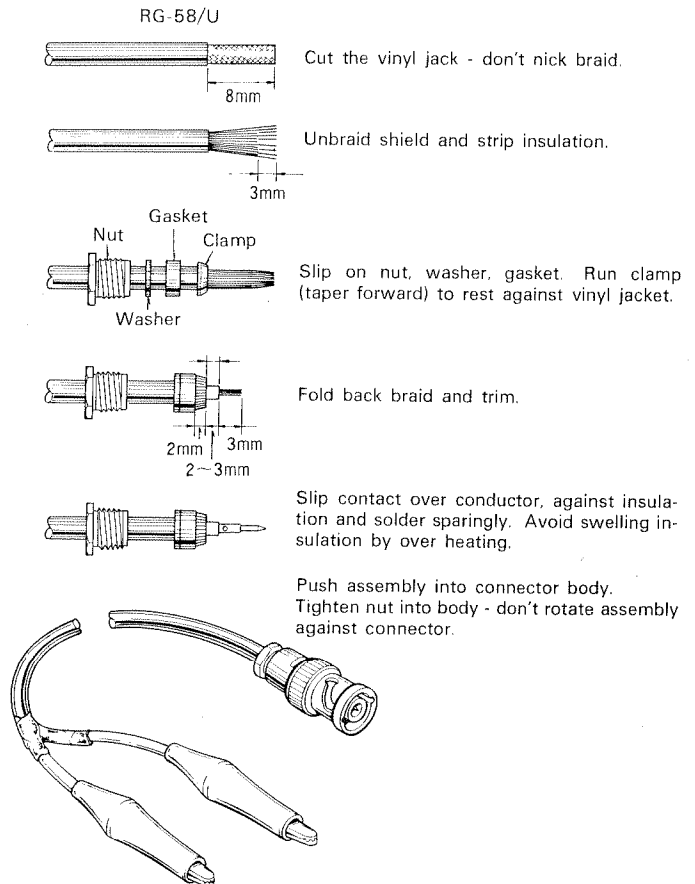


Fig. 3-2 Assembling a BNC connector cable

## 3.3 WARNING:

1. This unit contains a 1.3 kV high voltage circuit. Do not open the case unnecessarily. During adjustment or inspection, exercise care to prevent the possibility of electric shock.
2. **Caution:** When a spot is displayed on the CRT screen, reduce brightness by the INTENSITY control, or the phosphor will be damaged. A burned CRT will not be covered by warranty.
3. As with all solid state equipment, do not operate this unit in high temperature or humidity environments. So avoid direct sunlight.
4. **Caution:** Vertical input voltage should not exceed 600 Vp-p. Horizontal input voltage should not exceed 100 Vp-p.
5. Locate the SM-220 away from strong magnetic fields (I.E. power transformers), or trace distortion may occur. Do not place directly on top of the transceiver, etc.

## SECTION 4. CONTROLS, INDICATORS AND CONNECTORS

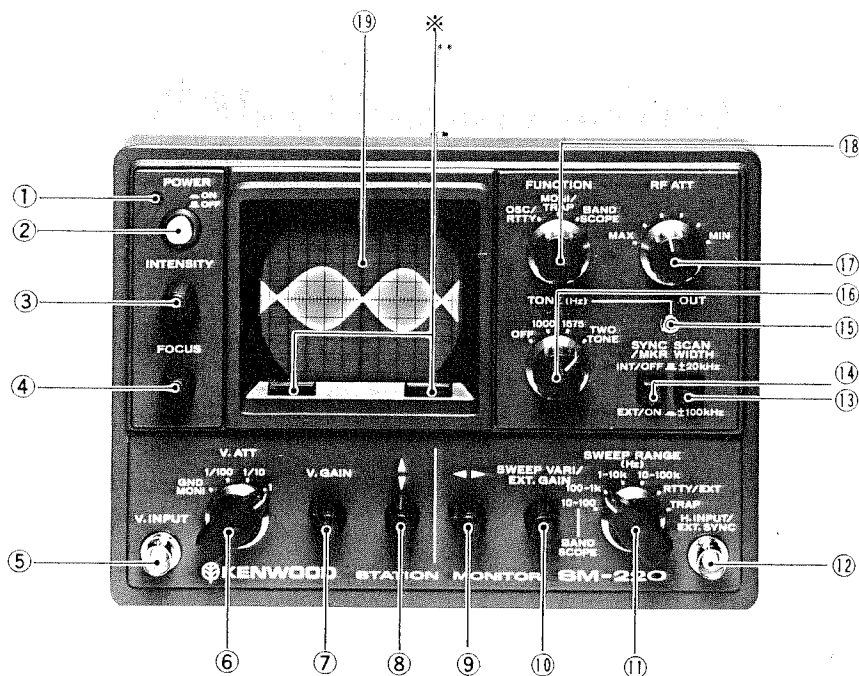


Fig. 4-1 Front panel

### ① POWER INDICATOR

This LED lights when the power switch is turned ON.

### ② POWER SWITCH

A push ON, push OFF switch controls all power to the instrument.

### ③ INTENSITY

This varies the brightness of the pattern on the scope screen. Clockwise adjustment increases the intensity.

### ④ FOCUS

Adjust this control to obtain the sharpest pattern on the scope screen.

### ⑤ V. INPUT

Vertical signal input terminal accepts oscilloscope input, or input from the transceiver IF-OUTPUT terminal.

### ⑥ V. ATT

Stepped input level control for the oscilloscope vertical amplifier. At position "1", V. INPUT signal is connected directly to the vertical amplifier. At the "1/10" and "1/100" positions, input is reduced proportionally. When the unit is used as a monitor scope, this switch should be set to GND-MONI position at which the vertical amplifier is grounded.

### ⑦ V. GAIN

Vertical amplifier gain control. Used in conjunction with the stepped V. ATT to adjust the size of the waveform pattern on the screen.

### ⑧ ▲ POSITION

Vertical position control. This control determines the display position along the vertical axis. Adjustment clockwise shifts

the pattern upward.

### ⑨ ◀ ▶ POSITION

Horizontal position control. This control determines the display position along the horizontal axis. Adjustment clockwise shifts the pattern to the right.

### ⑩ SWEEP VARI/EXT GAIN

This functions as the Sweep Fine frequency control when using the internal sweep. It is the SCAN TIME adjustment during Pan Display operation, and during oscilloscope operation, the horizontal input gain control.

### ⑪ SWEEP RANGE

Sweep frequency selector. This switch is used in conjunction with the SWEEP VARI/EXT GAIN control (10) to obtain the desired sweep frequency. During Pan Display operation, this switch should be set to the "10-100" position and again, during RTTY and TRAP display to their appropriate positions.

### ⑫ H. INPUT/EXT SYNC TERMINAL

Horizontal input and external sync signal input terminal. Apply mark signal to this terminal when observing RTTY cross pattern.

### ⑬ SCAN WIDTH

This switch is used during Pan Display operation, selecting either  $\pm 20$  KHz or  $\pm 100$  KHz scan width.

### ⑭ MARKER/SYNC INT-EXT

This switch is used during Pan Display operation to energize the in-built marker generator, or during oscilloscope operation as the sync selector. The oscilloscope is syn-

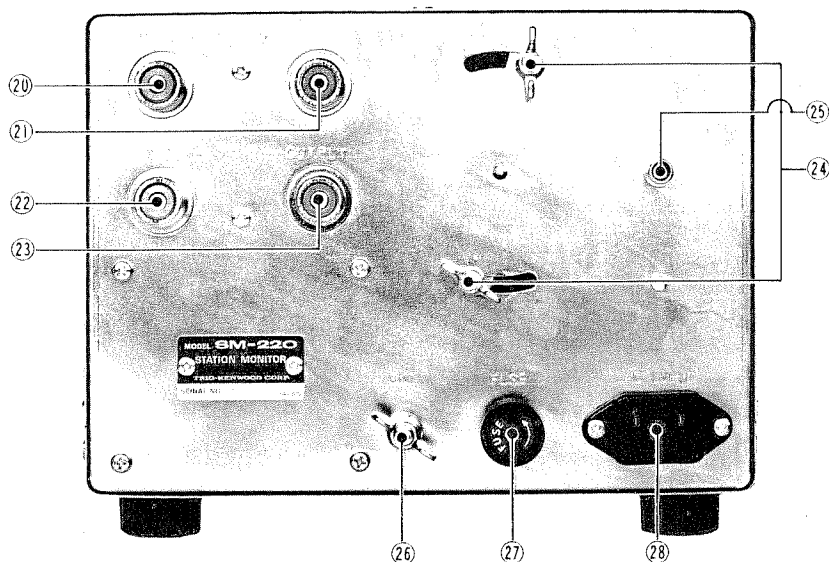


Fig. 4-2 Rear panel

chronized with the verticle input signal at the INT position, and at the EXT position with the signal applied to the EXT SYNC terminal (12).

**15 OUT**

Output terminal for the two-tone audio generator.

**16 FUNCTION SELECTOR FOR THE TWO-TONE AUDIO GENERATOR**

Can be set to OFF, 1000 Hz, 1575 Hz or TWO-TONE.

**17 RF. ATT**

RF input level control, used during MONI operation.

**18 FUNCTION**

This switch selects the display function of the station monitor; OSCILLOSCOPE or RTTY, MONITOR or TRAPEZOID, and Pan Display.

**19 CRT AND GRATICULE**

The smoked acrylic graticule affords easy waveform observation. When the Pan Display option is installed, the graticule may be replaced with the one supplied in the adapter kit. Remove by pressing at "X" points and withdrawing upward and out.

**20 RF INPUT**

For observation of RF output, connect the transceiver's OUTPUT to this terminal. When observing linear amplifier trapezoid waveform, amplifier RF OUTPUT should be connected to the scope RF INPUT.

**21 RF OUT**

Requires an antenna or dummy load for observation of RF signals.

**22 DRIVE INPUT**

Connect to transceiver ANT terminal when observing amplifier linearity (trapezoid waveform).

**23 DRIVE OUTPUT**

Connect to the linear amplifier RF INPUT terminal when observing amplifier linearity.

**24 HORIZONTAL TRACE TILT ADJUSTMENT**

The scope trace may be tilted by the earth's magnetic field, depending on the location where the oscilloscope is used. Corrected horizontal trace can be obtained by loosening these adjusting screws. After adjustment, tighten the screws securely.

**25 IF INPUT**

With the Pan Display option installed, connect the transceiver IF output (modified) to this terminal. (See Sect. 8, "Transceiver modification").

**26 GND**

Ground terminal. Connect to the transceiver ground terminal with the shortest lead possible.

**27 FUSE**

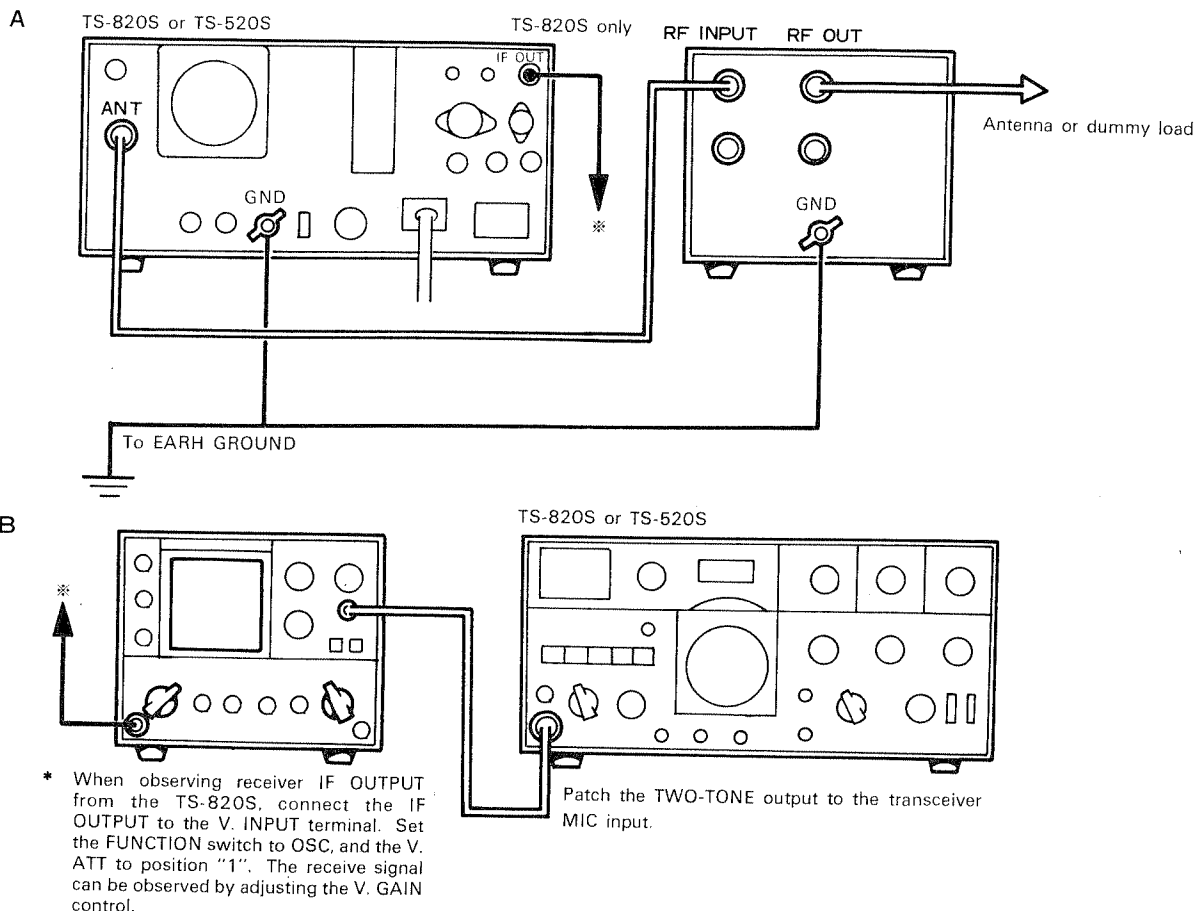
A 0.5A fuse is used. If the fuse blows, check the cause before replacing with the supplied spare.

**28 AC INPUT**

Power cable connector. Accepts the supplied power cable.



## SECTION 5. OPERATION



**Fig. 5-1. Cabling for transmit and receive displays**

### 5.1 TRANSMIT SIGNAL OBSERVATION

Connect the SM-220 and the transceiver as shown in Fig. 5-1.

Set the SM-220 controls as shown in Table 5-1. Adjust the transceiver for normal operation.

Speak into the microphone, the SSB signal is displayed on the CRT screen. Adjust the SWEEP-RANGE, SWEEP VARI, and RF ATT controls for the desired display.

#### Waveform examples:

Fig. 5-3 shows single tone waveforms, and Fig. 5-4 shows keyed CW waveforms.

Fig. 5-5 shows two-tone generator waveforms, when SM-220 output is patched to the transceiver microphone input terminal.

Fig. 5-6 shows voice waveforms.

FUNCTION	MONI/TRAP
RF ATT	MIN
TONE	OFF
SYNC/MARKER	INT/OFF
SCAN WIDTH	AS DESIRED
SWEEP RANGE	10-100, 100-1K
SWEEP VARI/EXT GAIN	CENTERED
◀▶	CENTERED
▲▼	CENTERED
V. ATT	GND MONI
FOCUS	SHARPEST TRACE
INTENSITY	MINIMUM FOR GOOD TRACE VISIBILITY
POWER	ON

**Table 5-1. Control settings, transmit signal observation**



## 5.2 RECEIVE SIGNAL OBSERVATION TS-820S

For receive signal observation, connect the TS-820S IF OUTPUT terminal to the SM-220 V. INPUT terminal.

Follow settings table 5-1, excepting:

FUNCTION	OSC/RTTY
V.ATT	1

Adjust the SWEEP-RANGE and SWEEP-VARI controls for the waveform desired.

### NOTE:

1. TS-820S IF OUTPUT requires attenuation, as shown in figure 5-2.
2. Fabrication of a patch cord is required.

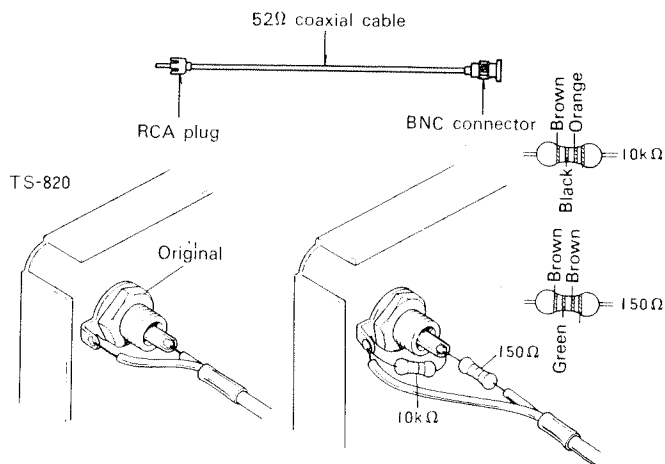


Fig. 5-2 TS-820S IF output matching

## TS-520/S

If, as outlined for the TS-820, a receiver IF Output display is desired from your TS-520/S transceiver, the following additional information applies.

### TS-520/S IF Output Installation

(May be installed at time of BS-5/BS-8 modification)

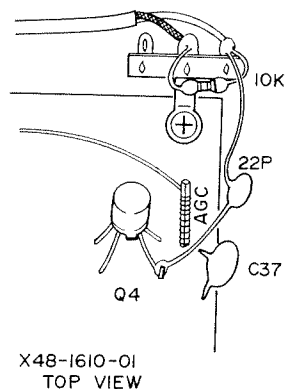
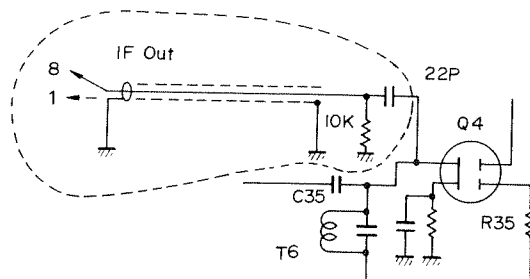
1. Remove power cable from the TS-520/S.
2. Remove top cover, unplug speaker line.
3. Remove bottom cover.
4. At the drain of Q4, add a 22 Pf 25V capacitor. KEEP LEAD SHORT.
5. From the second lead of the 22 Pf capacitor, add a 10K ohm 5% (or 10%) 1/4W (or 1/2W) resistor to ground. Again, keep leads short. (See Picture)
6. A 12 inch (30 cm) length of miniature 75 ohm lead will be run back along the wiring harness to the Remote 8P octal socket: Check for good mechanical connections, good solder connections, and no shorts. Insulate the capacitor, resistor, coax junction using heat-shrink or electrical tape.
7. Remove the 8P Octal socket (2 screws) and withdraw rearward. (See Fig. 8-5, Page 16)
8. Solder the coax ground shield to Pin 1.
9. Remove the 2 speaker line leads (White/Yellow) from Pin 8, and insulate. (This prevents the possibility of feed back between the Audio and IF sections.) Connect coax inner lead to Pin 8.
10. Check for good mechanical connections, good soldering, no shorts. Reinstall the Remote Socket.
11. Reinstall Bottom Case, reconnect the speaker, and reinstall the Top Case.
12. Cable-up the TS-520/S and SM-220, per Fig. 5-1. Operate per Section 5.2.

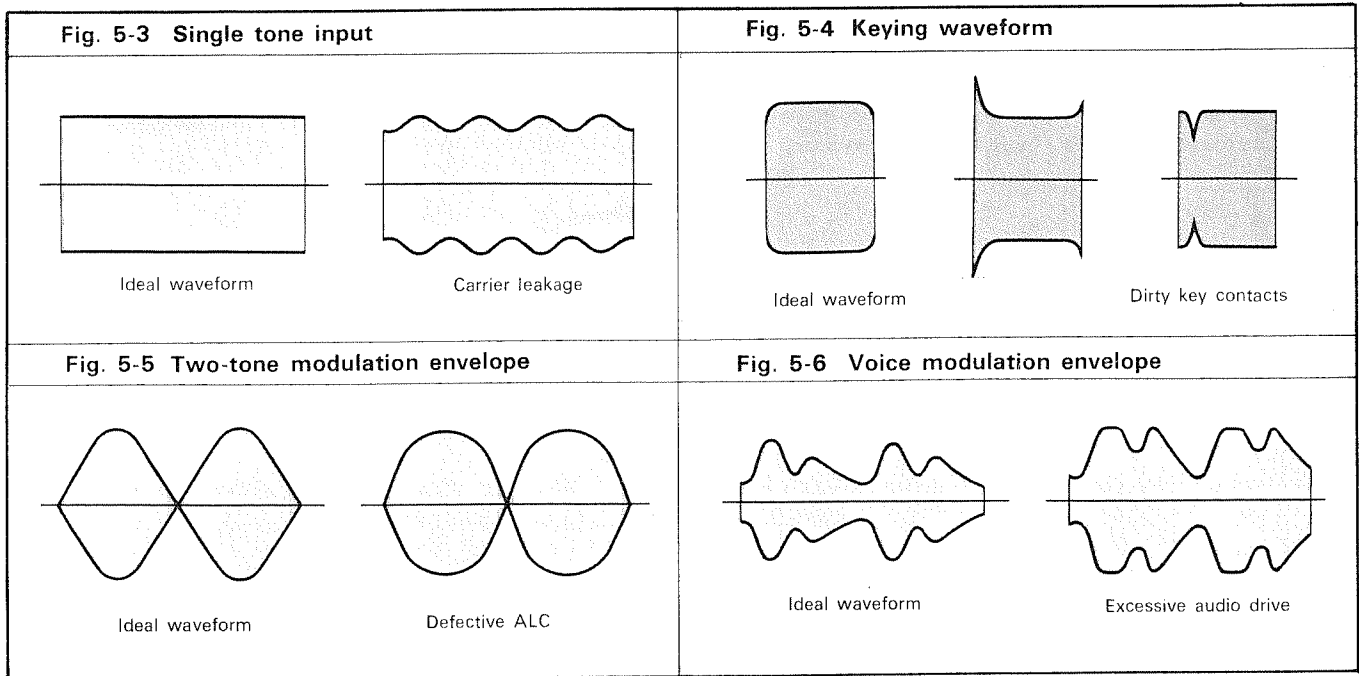
### Tools Required:

- #2 Phillips screwdriver
- 45W (or less) soldering iron, 60/40 Rosin Core Solder
- Wire stripper

### Material Required:

- 22 Pf 25V capacitor
- 10k ohm 5%, 1/4W (or 10% 1/2W) resistor
- Heat shrink tubing or electrical tape
- 12 inch (30 cm) 75 ohm miniature cable
- Terminal strip 3P





**WAVEFORM EXAMPLES**

**NOTE:**

For additional display information and examples, consult such sources as the radio amateur's handbook, radio handbook, etc.

**5.3 TRAPEZOID WAVEFORM OBSERVATION**

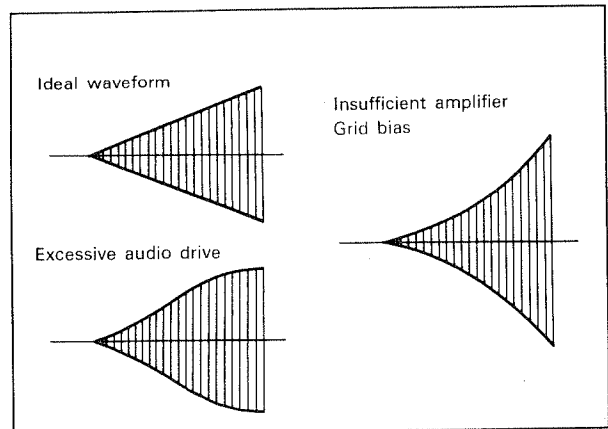
To observe amplifier linearity, connect the equipment as shown in Fig. 5-8.

Adjust the transceiver and linear amplifier for normal operation. Set the SM-220 controls as follows:

FUNCTION	MONI/TRAP
RF ATT	MIN
STONE	TWO TONE
MARKER/SYNC	INT
SWEEP RANGE	TRAP
SWEEP VARI/EXT GAIN	CENTERED
◀▶	CENTERED
◆	CENTERED
V. ATT	MONI

**Table 5-2. Control settings, Trapezoid waveform observation**

When the waveform appears on the scope screen, adjust the RF ATT, SWEEP VARI/EXT GAIN, ◆, and ▶◀ controls for the waveform size desired. Amplifier linearity can be analyzed from the waveform displayed on the screen. Fig. 5-7 shows typical waveforms.



**Fig. 5-7. Trapezoid waveforms**

**CAUTION:**

Don't burn your CRT screen by allowing the "DOT" to remain displayed at high intensity during NO-TRANSMIT periods. A burned CRT is not covered by warranty.

**NOTE:**

A trapezoid pattern may be observed with the linear amplifier OFF, but it is meaningless, as it is only a display of the exciter referenced to itself.

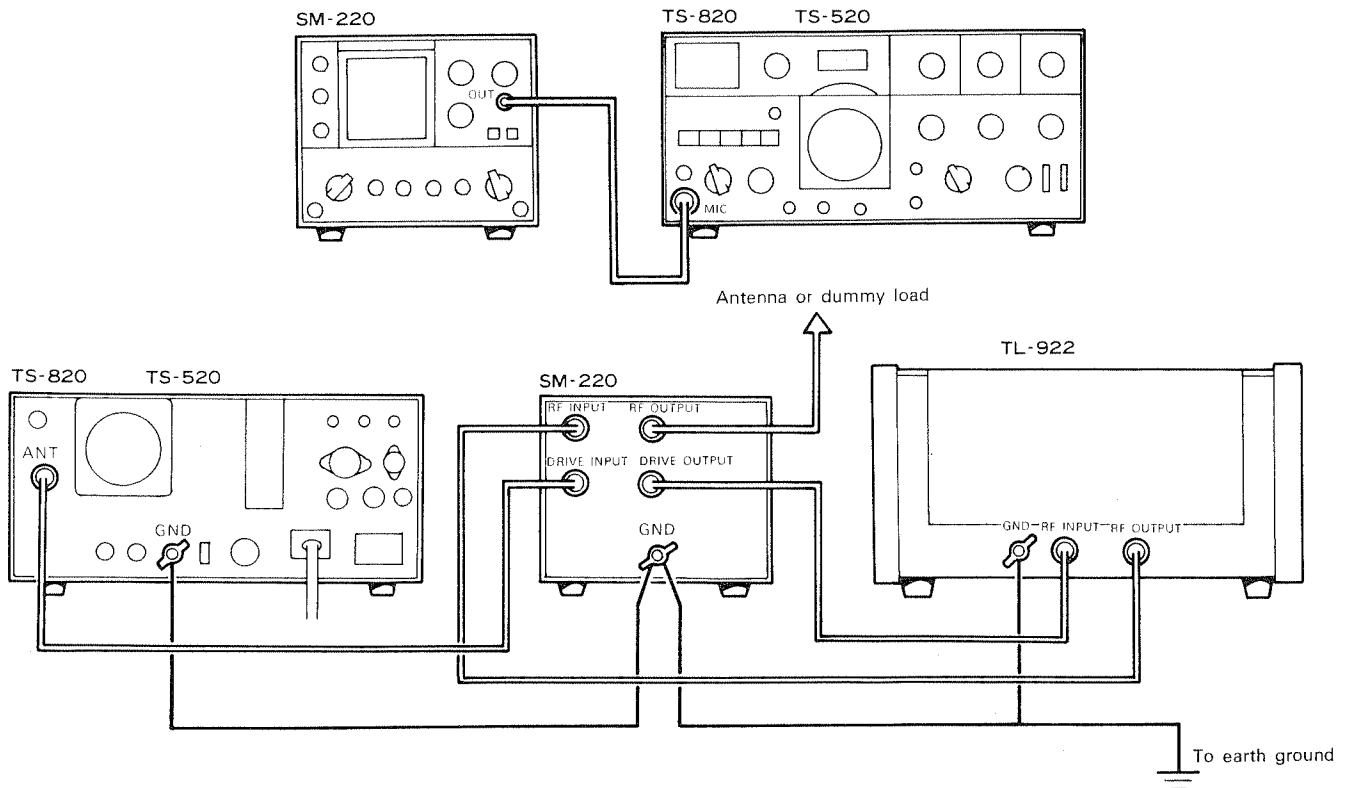


Fig. 5-8. Connection for trapezoid waveform observation

#### 5.4 RTTY CROSS PATTERN OBSERVATION

To display an RTTY cross pattern, connect the equipment as shown in Fig. 5-10. Set the SM-220 controls as follows:

FUNCTION	OSC/RTTY
SWEEP RANGE	RTTY/EXT
SWEEP VARI/EXT GAIN	CENTERED
◀▶	CENTERED
◆	CENTERED
V. GAIN	CENTERED
V. ATT	"1"
FOCUS	SHARPEST TRACE
INTENSITY	MINIMUM FOR GOOD TRACE VISIBILITY
POWER	ON

Table 5-3. Control settings, RTTY cross Pattern Display

While receiving an RTTY signal, adjust the V. ATT, V. GAIN and SWEEP VARI/EXT GAIN controls for the desired display size. Fig. 5-9-A pattern shows optimum tuning.

Fig. 5-9-B pattern shows off-tuning.

Fig. 5-9-C pattern shows the demodulator filter "Q" to be low. A horizontal line is displayed for a Mark signal, and a vertical line is displayed for a Space signal.

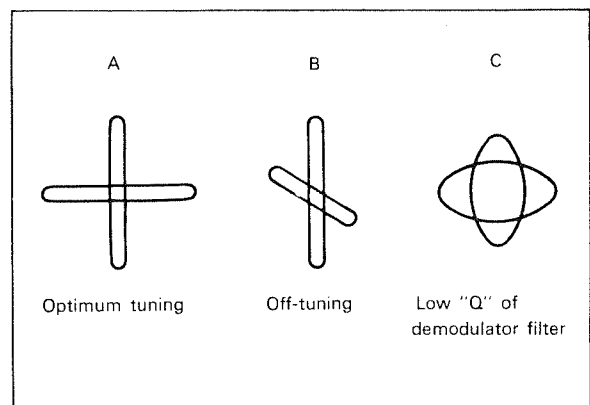
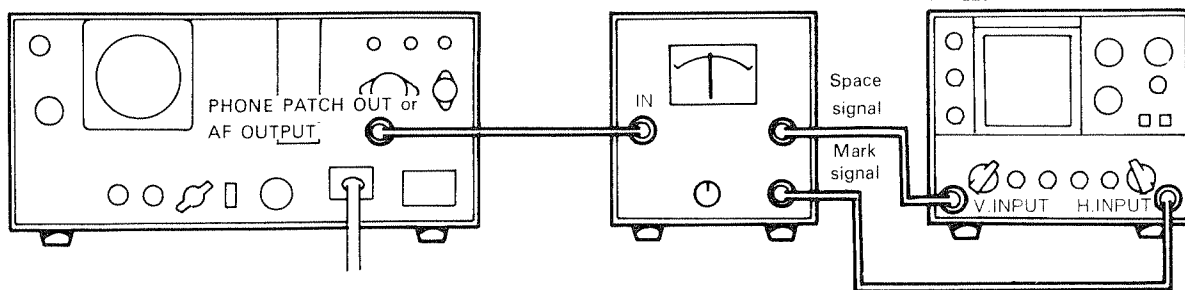


Fig. 5-9. RTTY cross patterns

TS-820  
TS-520



Note: Adjust the demodulator balance control so the Space signal level equals the Mark signal level (symmetrical display).

Fig. 5-10. Cabling for RTTY cross pattern observation

## 5.5 OSCILLOSCOPE OPERATION

The SM-220 will provide excellent oscilloscope performance. It features wide bandwidth (2 Hz ~ 10 MHz) and high sensitivity (20 mV/DIV), and is designed for general transceiver measurements.

The oscilloscope permits display of various waveforms (sine, square wave, carrier, modulation envelope, SSB, etc.) in the 2 Hz to 10 MHz frequency range.

For oscilloscope operation, set the FUNCTION switch to OSC/RTTY. The signal to be measured is connected to the V. INPUT terminal.

1. Measurement of 2 Hz — 10 MHz waveforms (Sine, square wave, carrier, modulation envelope, SSB.)
2. Measurement of Lissajous' figures (Ex. Fig. 5-11). (Set the sweep range to RTTY/EXT, and connect an audio generator, as an external sweep source, to the horizontal input terminal.)

FUNCTION	OSC/RTTY
RF ATT	AS DESIRED
SWEEP RANGE	RTTY/EXT
SWEEP VARI/EXT GAIN	CENTERED
◀▶	CENTERED
⬆	CENTERED
V. GAIN	CENTERED
V. ATT	AS DESIRED

Table 5-4. Control settings, oscilloscope operation

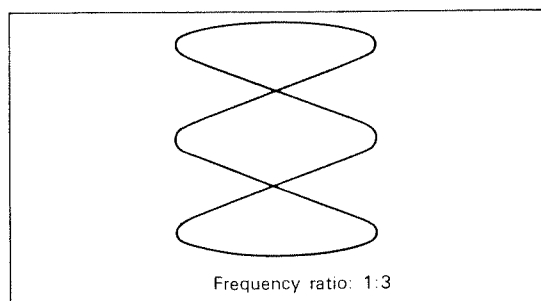


Fig. 5-11. Lissajous' figure example

## SECTION 6. CIRCUIT DESCRIPTION

### 6.1 VERTICAL CIRCUITS

The input signal connected to the V. INPUT is fed through a DC blocking capacitor, to the step attenuator, and is applied to the vertical amplifiers.

The vertical amplifier, a direct-coupled differential amplifier using FET input, amplifies signals from 2 Hz — 10 MHz. The amplifier gain is approximately 54 dB. Attenuation, gain and position controls are provided externally, and DC balance is accessed through the bottom cover.

### 6.2 HORIZONTAL CIRCUITS

The horizontal circuit is composed of a saw-tooth time base oscillator and a horizontal amplifier circuit. The saw-tooth oscillator (Q118, Q119) is provided with a DC level stabilizer.

The horizontal amplifier is a direct-coupled differential amplifier using an FET (Q122) input. Amplifier gain is approximately 30 dB, and is variable approximately 10 dB by the H. GAIN. Sweep range, variable sweep, position and gain controls are provided.

### 6.3 MONITOR CIRCUIT AND TWO-TONE AUDIO GENERATOR

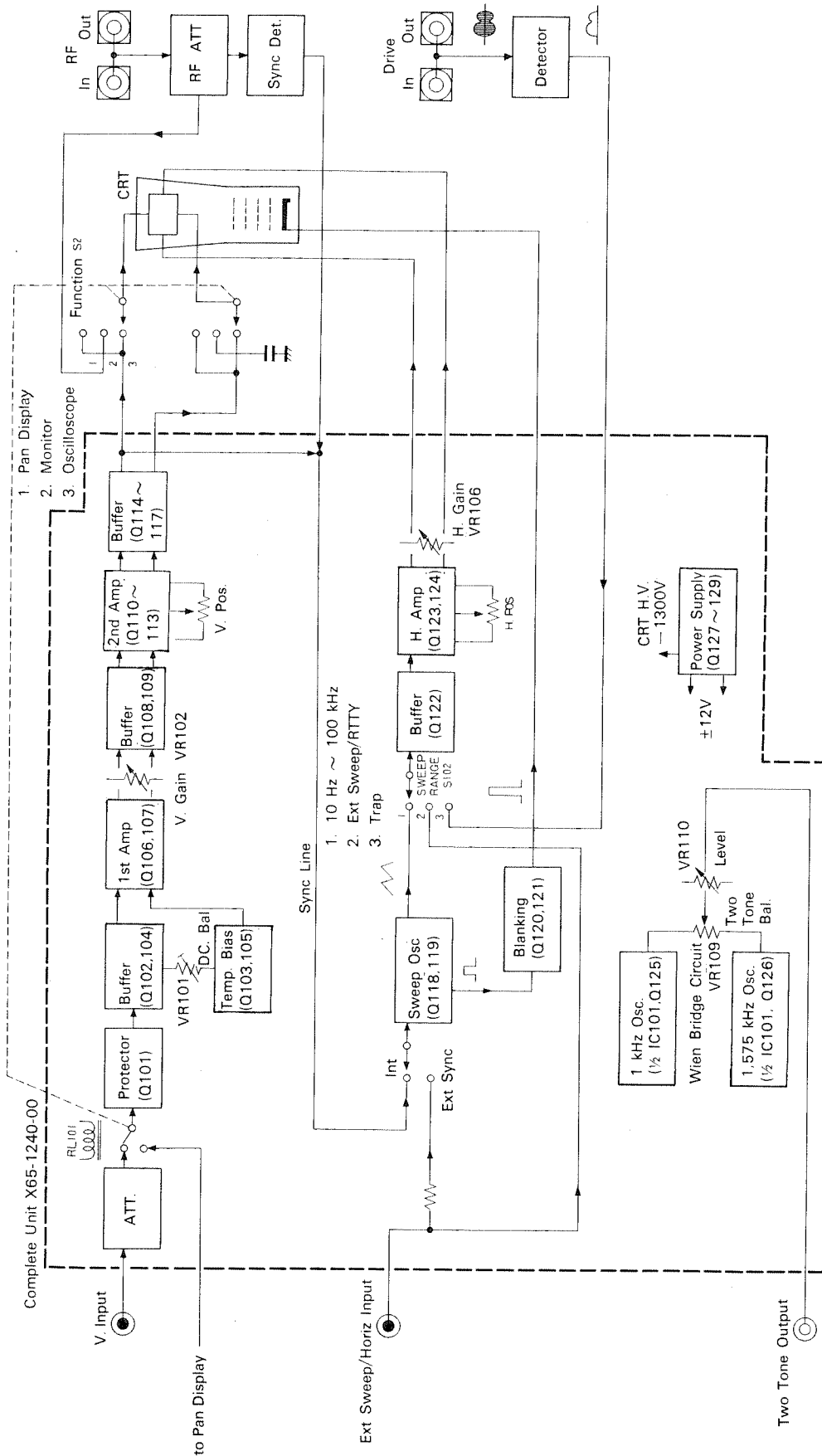
Transmit RF power is applied to the vertical deflection plates through the RF ATT. This signal is also sampled and applied via the detector circuit to the horizontal amplifier as a sync signal. During trapezoid waveform observation, exciter power from the DRIVE circuit is sampled and detected, and fed to the horizontal amplifier.

The Wien bridge two-tone generator provides stable oscillation at 1000 Hz and 1575 Hz.

### 6.4 POWER SUPPLY

The power supply provides regulated  $\pm 12V$ , 150V for the final amplifier, and 1.3 kV for the CRT.

# BLOCK DIAGRAM



## SECTION 7. ADJUSTMENTS AND MAINTENANCE

### 7.1 GENERAL INFORMATION

Your SM-220 has been factory aligned and tested to specification before shipment. Under normal circumstances it will require no further attention if operated in accordance with the instructions in this manual. If, however, readjustment becomes necessary, the following procedures may be performed. Any other adjustments should be referred to your dealer.

#### NOTE:

Attempting further service or adjustment without factory authorization can void the instruments warranty.

A full service manual is available as a separate publication.

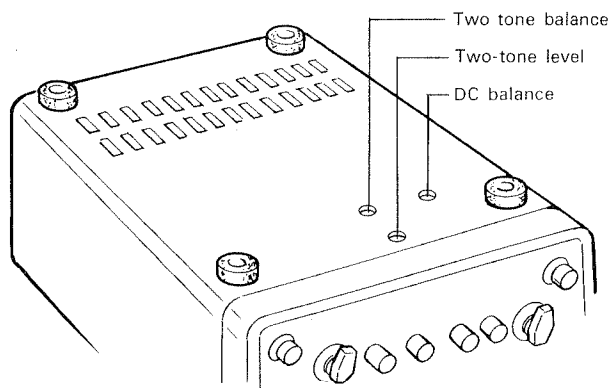


Fig. 7-1. Adjustment access (case bottom)

### 7.2 VERTICAL DC BALANCE

If the vertical trace shifts up and down as the V. GAIN is rotated, adjust the DC BAL for stationary display.

Set the V. ATT to GND and turn the V. GAIN fully counterclockwise. Set the  $\blacktriangle$  (vertical) POSITION to the screen center line.

Turn the V. GAIN clockwise; if the trace shifts up or down, adjust the DC BAL (VR101 on the printed circuit board) so the trace returns to its original position. Repeat this adjustment until the trace remains stationary when the V. GAIN is rotated.

This adjustment should be made after the unit is stabilized (about 15 minutes).

### 7.3 TWO-TONE BALANCE

The 1000 Hz and 1575 Hz oscillators are factory adjusted for equal level. If the displayed transmit signal waveform is not as shown in Fig. 7-2, it indicates the two-tone generator is unbalanced due to transceiver IF crystal filter or MIC amplifier characteristics. This may be corrected by adjusting the balance control, VR109 in either LSB or USB mode, whichever is used more frequently. Two-tone output level is adjusted with VR110 (two-tone level adj.).

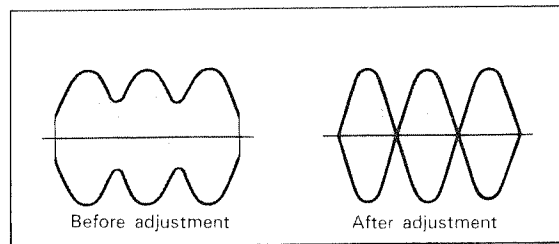


Fig. 7-2. Two-tone oscillator waveform

### 7.4 ORDERING SPARE PARTS

When ordering replacement or spare parts, specify:

1. Model number and serial number.
2. Printed circuit board number and schematic designation of the component(s) desired.
3. Component(s) description, name or number.

Should it become necessary to return the unit for repair, repack in its original boxes and packing, and include a full description of the problems experienced.

## SECTION 8. PAN DISPLAY OPTION

### 8-1. GENERAL INFORMATION

To monitor signal conditions in the vicinity of your receive frequency, a Pan Display Plug-In is available as an option to the SM-220.

The BS-5 is designed to match the TS-520 series IF frequency (3395 kHz), and BS-8 the TS-820 series IF frequency (8830 kHz).

When using either the BS-5 or BS-8, a minor wiring addition is required in the transceiver.

The Pan Display is easily installed in the SM-220, and requires no soldering ALL connections are accomplished by multiconnectors.

### 8-2. DESCRIPTION OF THE BS-5 AND BS-8 PAN DISPLAY

When the BS-5 or BS-8 is installed in the SM-220 and connected to the transceiver, signal conditions in the vicinity of the receive frequency can be displayed over a  $\pm 20$  kHz or  $\pm 100$  kHz range. The Pan Display amplifier employs a logarithmic compression system, so weak and strong signals

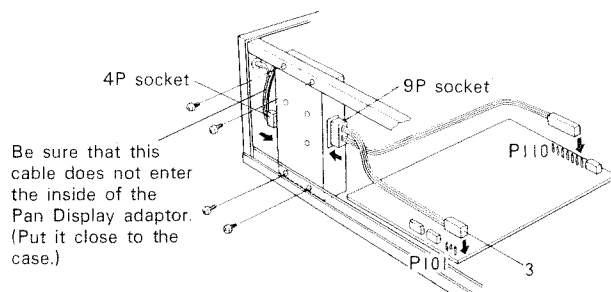


Fig. 8-1. Installing the Pan Display adaptor

can be monitored simultaneously. The narrow bandwidth filter permits monitoring of adjacent signals even under adverse receiving conditions, in both SSB and CW modes.

### 8-3. INSTALLATION BS-5/BS-8 (See Fig. 8-1)

#### WARNING:

Disconnect the AC Power Cable before opening the SM-220.

1. Remove the upper and lower cases. Mount the Pan Display unit to the frame with the 4 screws supplied.
2. Insert the 4-pin keyed connector (from the RCA jack) in the rear, and the 9-pin keyed connector in the front through the windows provided on each side of the adapter housing.
3. Insert the 4-pin keyed connector in position P101, left front (adjacent to the V. ATT shield), and the 7-pin keyed connector in position P110, right side, (adjacent to the main filter capacitors).

### 8-4. ADJUSTMENT OF THE BS-5/BS-8 (See Fig. 8-2)

The BS-5 or BS-8 must be adjusted before use. For adjustment, the antenna must be disconnected from the transceiver.

1. Set the SM-220 FUNCTION switch to BAND SCOPE (Pan Display).
2. Depress the MARKER switch (ON), center the display by the ◀▶ POSITION control and center the V. GAIN control. Adjust the ▲ POSITION to shift the trace to the bottom of the graticule. With the SCAN WIDTH set to the WIDE (100 kHz) position, turn the scan width adjustment VR202 until the marker signal moves to the scope center line. (Fig. 8-3A)
3. Turn the MARKER OFF. Set the transceiver RF GAIN to MAX, the FUNCTION switch to CAL 25 kHz, and peak the drive control for MAX "S" meter reading. At this time, check that 9-11 waveform peaks ("SPIKES") appear on the CRT screen, as shown in Fig. 8-3B. If necessary, reset the center frequency adjustment trimmer TC201 and the scan width adjustment

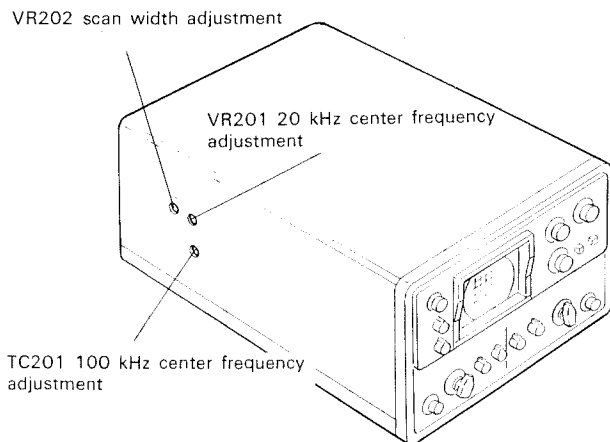


Fig. 8-2. Pan Display adjustment

VR202 (STEP 2), until the waveform shown in Fig. 8-3B is obtained.

#### NOTE:

Make certain you have actually adjusted the center frequency to the receiver. If necessary, find a single signal to verify this adjustment.

Before replacing the top and bottom covers, adjust the BS-5/BS-8 Input Transformer T1, located through the opening on the BS-5/BS-8 lower left corner. With the transceiver Function Switch at the CAL 25 kHz position, peak T1 for maximum vertical signal. Use a nonferrous (PLASTIC) tool. CAUTION: DO NOT use a metal screwdriver — the transformer's ferrite core may crack and freeze (not turn) in the transformer.

4. Turn off the 25 kHz calibrator, turn on the marker. Set the SCAN WIDTH to the NARROW (20 kHz) position, and adjust VR201 for CENTERED marker display, as previously outlined in step 2.

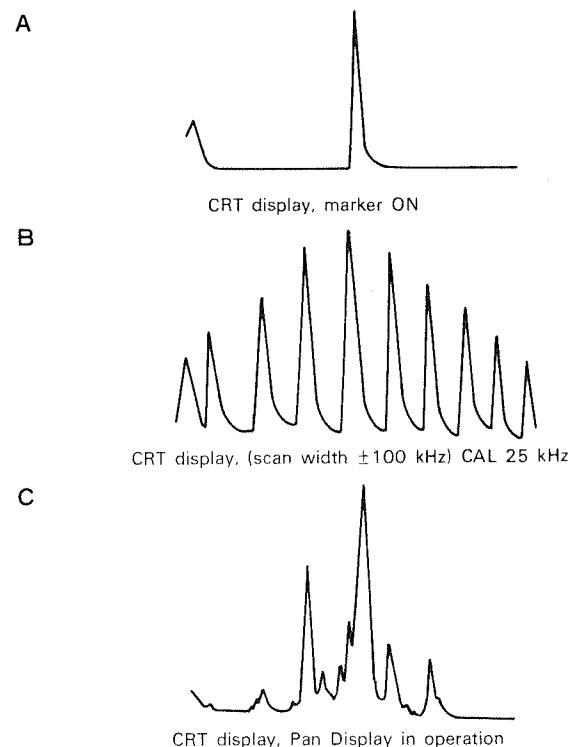


Fig. 8-3. Pan Display waveforms

### 8.5 OPERATION OF THE BS-5/BS-8

1. Replace the graticule with the one supplied with the Pan Display kit.
2. Set the SM-220 FUNCTION and SWEEP VARI/EXT GAIN switch to the Pan Display (Band Scope) position.
3. Adjust the ▲ POSITION until the trace coincides with the bold line at the lower portion of the graticule. Turn the MARKER ON and adjust the ◀▶ POSITION so the marker signal is centered.



4. Turn the MARKER OFF, connect the antenna and set the transceiver in receive mode.

A display as shown in Fig. 8-3C should appear on the scope.

Adjust the sweep so the display doesn't flicker. Excessive scan speed will distort the display.

Also a receiver and discontinued models can be used for Band Scope function as following signal input.

- a) TS-900  
NB unit (X54-1040-10) pin number 31 with 1000 pF coupling capacitor.
- b) TS-511  
NB unit (X54-1000-00) pin NBI with 5 pF coupling capacitor.
- c) R-599  
NB unit (X54-1080-10) pin IN with 100 pF coupling capacitor.

## 8.6 TRANSCIVER MODIFICATION

TS-520 and TS-820 series transceivers have no Pan Display output terminals: the coaxial cable supplied with BS-5/BS-8 must be installed as follow:

1. Installation of the coaxial cable with RCA plug.

Solder the cable to the transceiver Remote 8P (octal) plug as shown in Fig. 8-4.

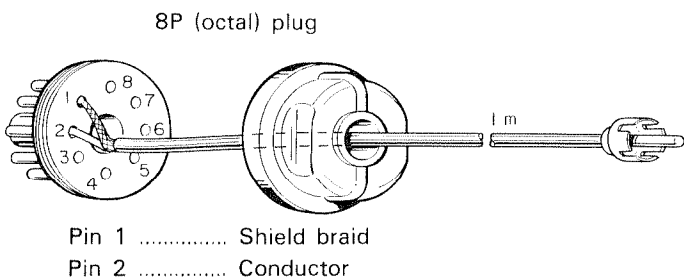


Fig. 8-4. Pan Display output cable

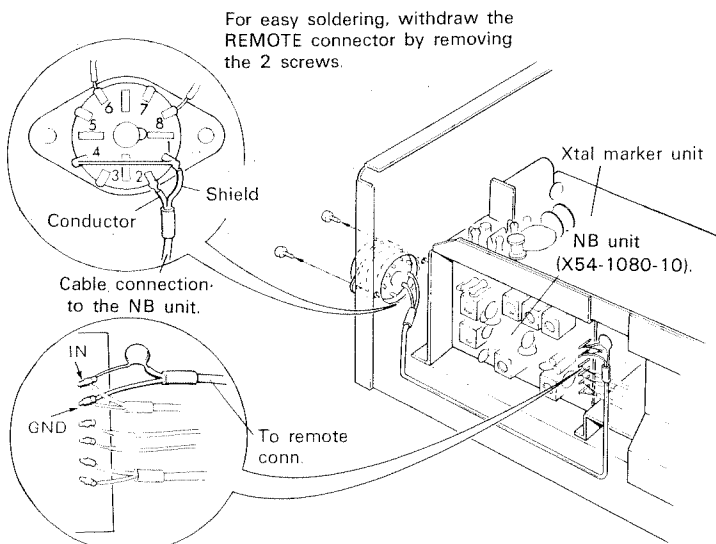


Fig. 8-5. TS-520 series IF sample cable installation

2. TS-520 series IF sample cable.

### WARNING:

Disconnect the AC power cable before opening the transceiver.

Remove the case and solder the capacitor side of the coaxial cable to the INPUT and GND terminal on the NB UNIT (X54-1080-02) printed circuit board located on the left side of the transceiver as viewed from the front. Solder the other end of the cable to the Remote 8P (octal) plug, Pin 1 and Pin 2. (Refer to Fig. 8-5.)

3. TS-820 series IF sample cable

### WARNING:

Disconnect the AC power cable before opening the transceiver.

- a) Remove the case and solder the capacitor side of the coaxial cable to the RIF GND terminal on the bottom of the IF UNIT (X48-1150-00) printed circuit board, located on the left side of the transceiver as viewed from the front. Solder the other end of the cable to the Remote 8P (octal) plug: Pin 1 (shield braid) and Pin 2 (conductor). The green lead between PHONE PATCH OUT and Pin 8 of the remote plug should be cut off and discarded. (Refer to Fig. 8-6.)

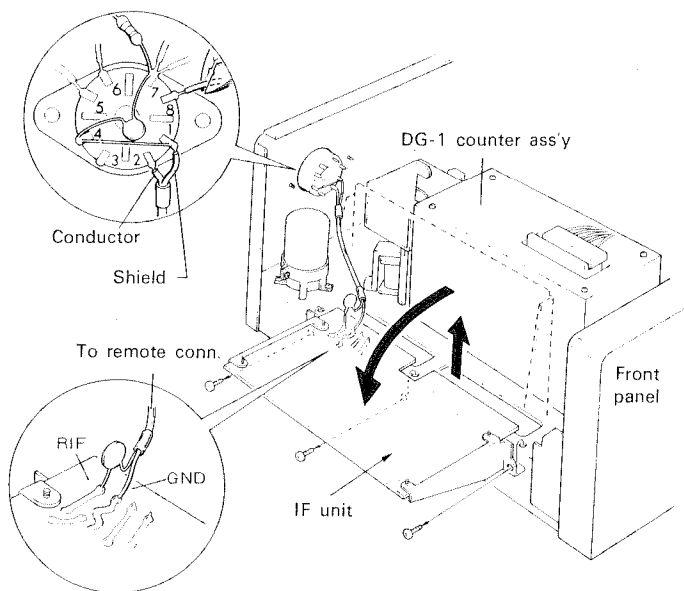
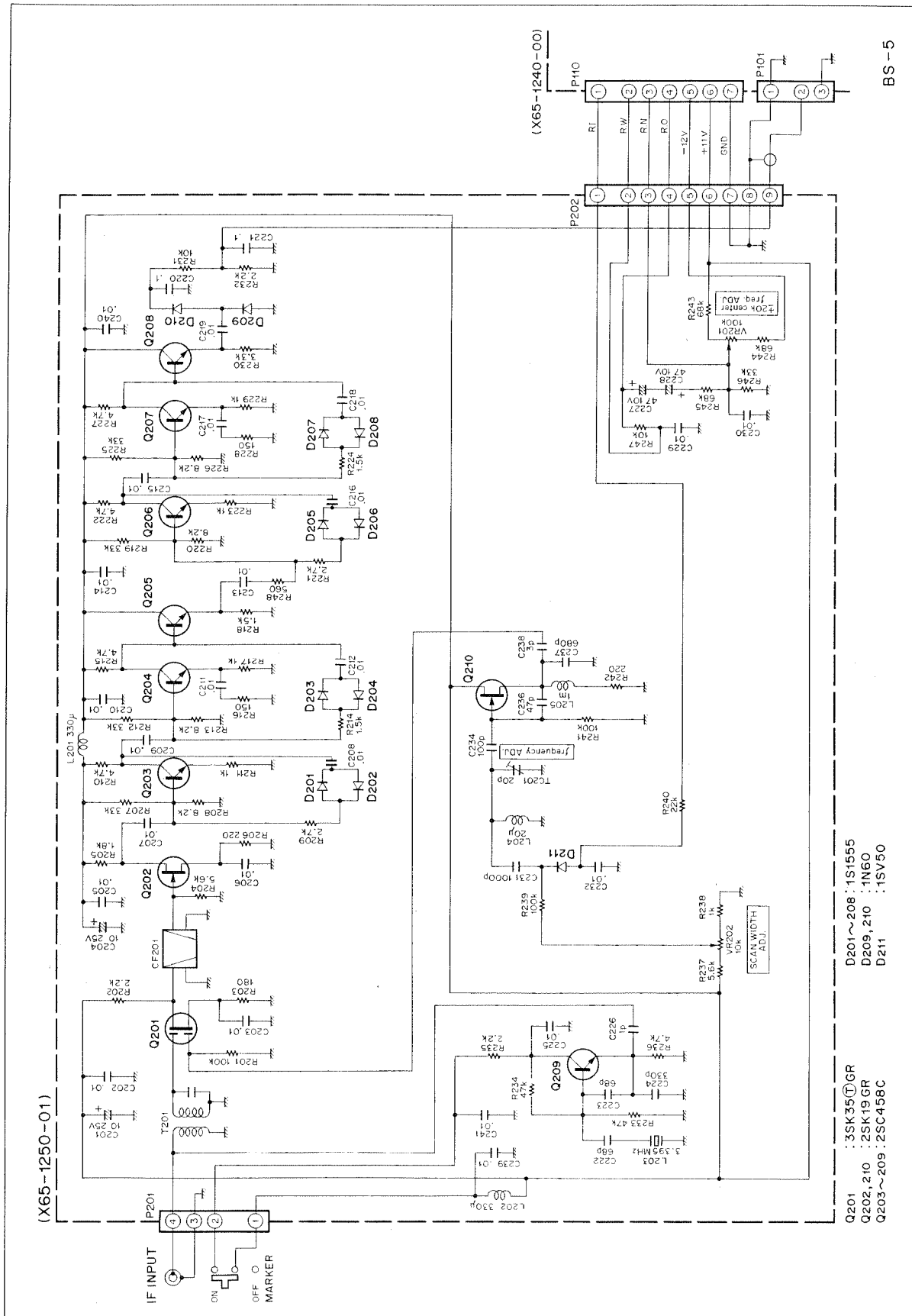


Fig. 8-6. TS-820 series IF sample cable installation

- b) Solder the matching resistors to the IF Output terminal. Leads must be as short as possible. (Refer to Fig. 5-2.)

# DIAGRAM BS-5



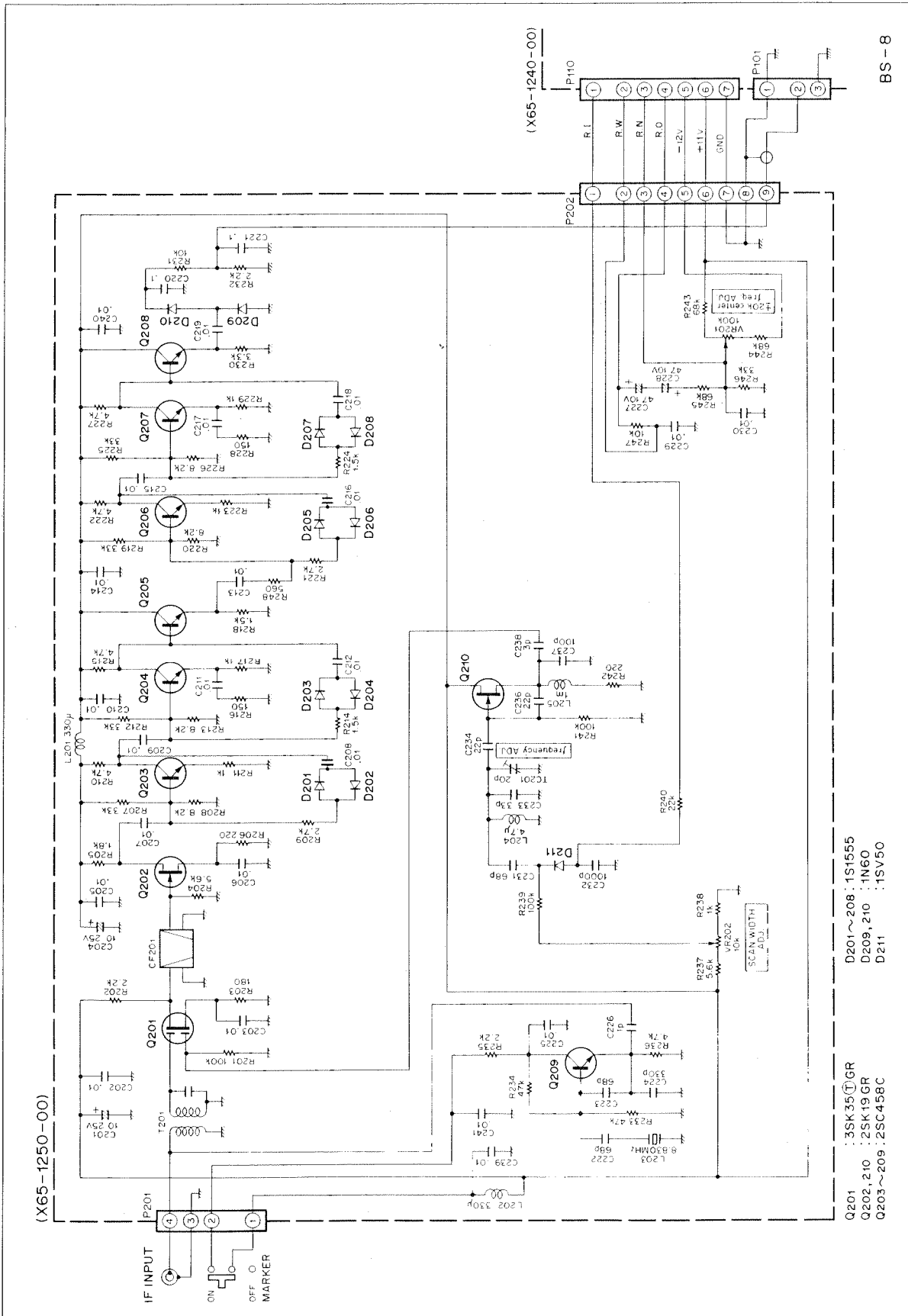
(X65-1250-01)

(X65-1240-00)

BS-5

- Q201 : 3SK35(GR)
- Q202, 210 : 2SK19 GR
- Q203~209 : 2SC458C
- D201~208 : 1S1555
- D209, 210 : 1N60
- D211 : 1SV50

# DIAGRAM BS-8



BS-8

- Q201 : 3SK35(IGR)
- Q202, 210 : 2SK19 GR
- Q203~209 : 2SC458C
- D201~208 : 1S1555
- D209, 210 : 1N60
- D211 : 1SV50

## MEMO

### CAUTION

If the SWEEP RANGE selector is switched to the 1-10k or 10-100k position while the transceiver is in reception mode, the built-in oscillator of the SM-220 will interfere with reception.

Avoid using these ranges in reception mode.

B58-0705-00

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A product of  
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