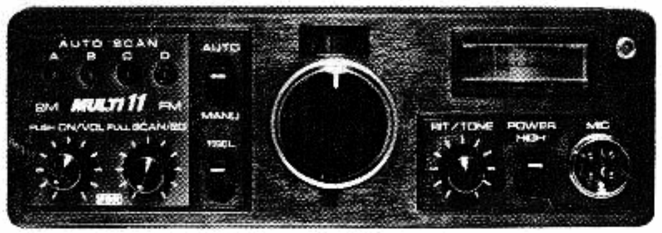
FDK



FM 2M
10W/1W
FIXED 23 CHANNELS
AUTO SCANNING 4 CHANNELS

INSTRUCTION MANUAL

FUKUYAMA ELECTRONICS CO., LTD

Thank you for your having purchased our product.
Although the set was produced under a severe quality control, you are requested to take it at once to the shop from whom you have purchased or directly to our Service Dept. should there be any breakage or trouble in the course of transportation. We shall be glad to repair or make any necessary adjustments soonest possible.
Please advise us the number of the set for all inquiries, which should be sent to the following address:

Service Dept.
FUKUYAMA ELECTRONICS
12-2, 2-chome, Fuji-cho, Hoya-shi, Tokyo 188, JAPAN

CONTENTS

SPECIAL FEATURES

■ **Built-in Auto Scan Device**

Since the 4-channel auto-scan device is built-in aside from the fixed 23 channels, once it is switched from the fixed channel to the auto-scan (one-touch push-button switching method) the 4 auto-scan channels, ABC and D, are automatically searched and the LED scanning is stopped by the channel radiating the radio wave and thus reception is commenced. The auto-scan begins operating when the message transmission has ceased. When the searched party is found, switch from AUTO to MANU, lock the channel and begin QSO. One-touch QSY is also possible by keeping the A channel locked and switching to the fixed channel. It is also possible to lock the channel by MANU, and switch to the 4 channels, ABC and D, one after another at will by the SEL switch.

It is very convenient when the crystal for the Club Channel or Repeater Channel is inserted into the AUTO-SCAN channel, as it enables a rapid QSY from other channels to the latter. Moreover, a wide selection is made possible, since there are 4 auto-scan channels.

Furthermore, if the crystal on the transmission side is set to the auto-scan channel, at the time of repeater operation, reception by the fixed channel and transmission by the auto-scan channel will be possible by the AUTO-MANU change-over switch.

By this built-in Auto-scan device, the ease of operation and mobility, which are highly demanded for car transceivers, have been maximized.

■ **Complete Transmitting and Receiving Narrow-Wide Bands Switch-Over System**

This is the revolutionary new mechanism (utility model pending), having adopted the narrow-wide band switch-over system for the first time on the 2mFM transceiver, thus solving at one stroke the problem of over-crowding of the 2m Band and the resulting interference. Not only for transmitting but also receiving as well can be switched-over from the existing wide band (30-40 KHz separation) to the narrow band (15-25 KHz separation era hereafter) just by a single switch.

By converting to the narrow band not only over-crowding of 2m is avoided, enabling the efficient use of the limited amateur band, but also shutting-out already interference from the narrow-band stations. "Clean QSO" is the field of monopoly for the MULTI-11.

■ **Built-in Receiving Booster for Super-Sensitivity**

For the RF stage, 2 stages of specially selected dual gate MOS type FET are used.

Compared to the conventional RF 1 stage type transceiver, another stage was added, bringing about the same effect as connecting the receiving booster. This is the special specification long sought after by the amateur radio mania for its amazingly levelled-up receiving sensitivity.

■ **Using "Highly Efficient 2-stage Crystal Filter"**

This was adopted for the first time in the trade for the multi series, additionally using 2 stages of crystal filters, which power has already been proven.

The set will show, more than ever efficiency in DX communication by its overwhelming power against cross modulation and sensitivity suppression coupled with its super sensitive characteristics.

■ **Discriminating Light for Crystal Loading**

For the fixed 23 channels, the discriminating mechanism was adopted whereby only the channel loaded with the crystal is lighted, thus enabling the rapid selection of only the lighted channel without remembering whether the crystal has been loaded or not.

■ **Adoption of Multi-function Meter**

With only a single meter transmission output power is indicated when transmitting and the S meter for the reception signal strength goes into operation upon receiving.

F staggering is measured by the change-over switches for calibration and center meter

■ **Built-in Fine Adjustment for Receiving Frequency (±5 KHz variable RIT)**

For the F staggering station, you can Zero-in with the other party's frequency by the RIT switch varying the receiving frequency by ±5 KHz, thus reducing noise and enabling clear reception. RIT is an absolutely necessary function, as at the narrow-band era, even a small F staggering can become the cause for a reception barrier.

■ **Built-in Calibrator Circuit for Measuring F Staggering**

Calibration circuit for correcting frequency at the time of additional installation of crystals is built-in enabling an easy adjustment by merely looking at the meter.

■ **Built-in Patent (AFB squelch circuit)**

Fukuyama's unique AFB squelch circuit is built-in, which was specially designed for use in car transceivers. This is a completely smooth squelch touch having solved "voice interruption" due to excessive irregularities and fading.

■ **Transmission Output High (10W)/Low (about 1W) 2-stage Change-over System**

■ **Built-in Tone Oscillator for Adjustment**

With TEST button for radiating F2 wave, which is convenient for test transmission and adjustment.

■ **Built-in Protective Circuit for Final Transistor**

When the protective circuit operates, the fixed channel indication lamp is extinguished, thus indicating the situation.

* One-touch slide type angle for car installation
* Speaker with front incline design
* ANT change over diode switch
* With complete protective device against reverse connection with power source
* With frequency adjustment trimmer (for additional crystal setting) for transmission and reception

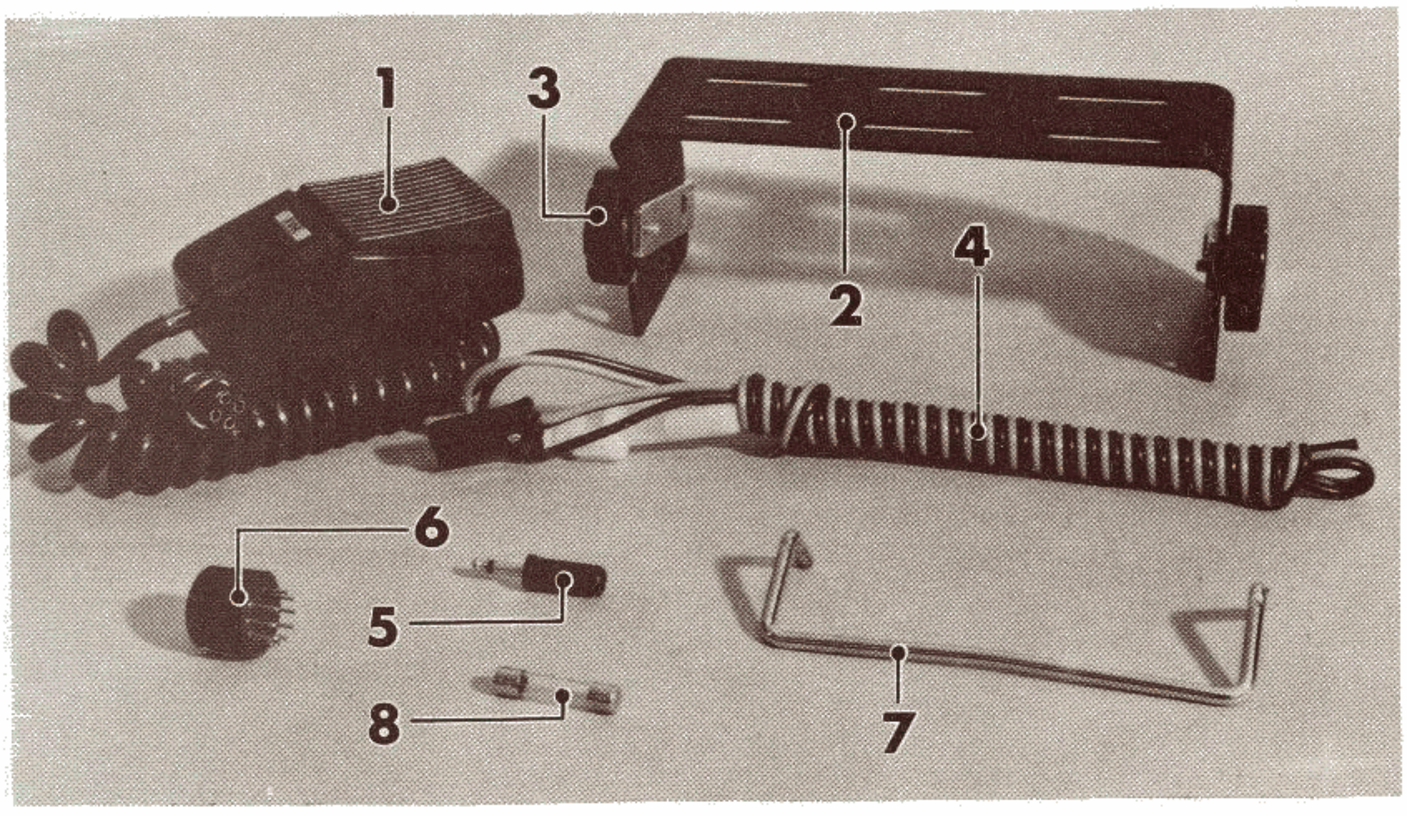
ACCESSORIES

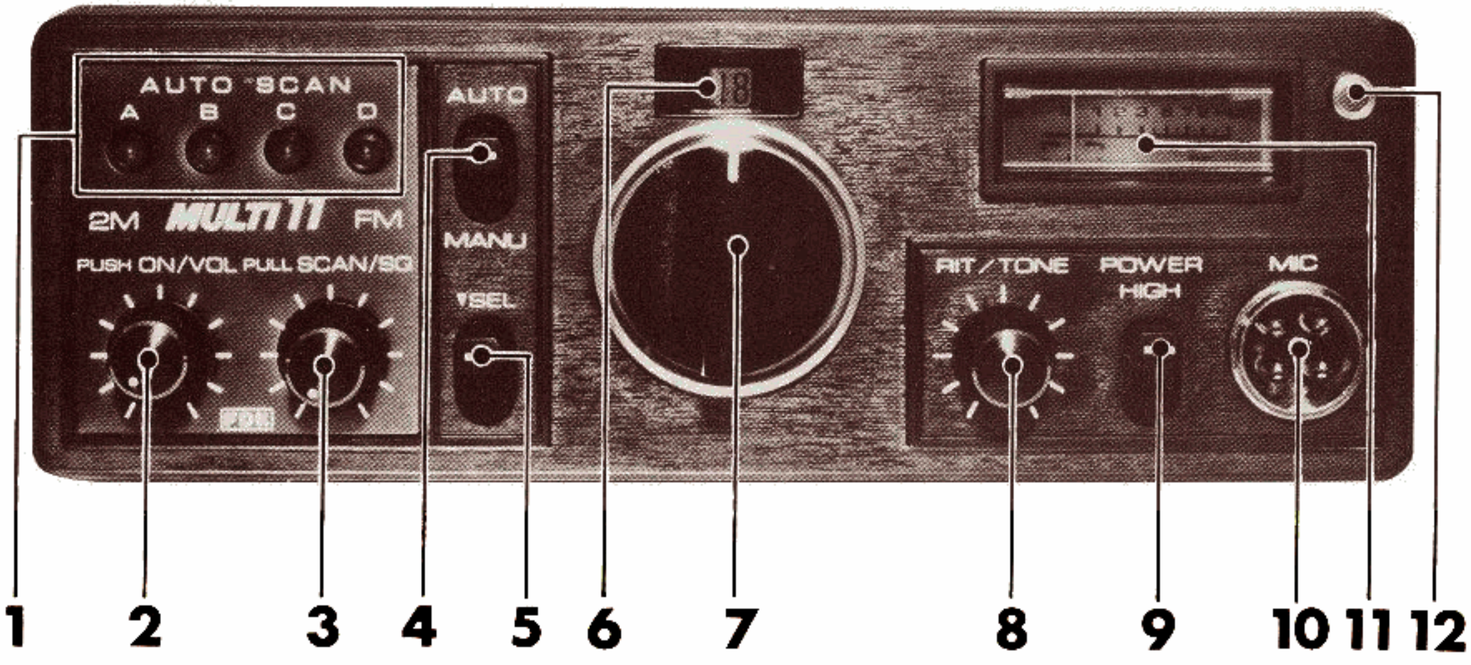
Please check the following accessories, which are furnished with the set:

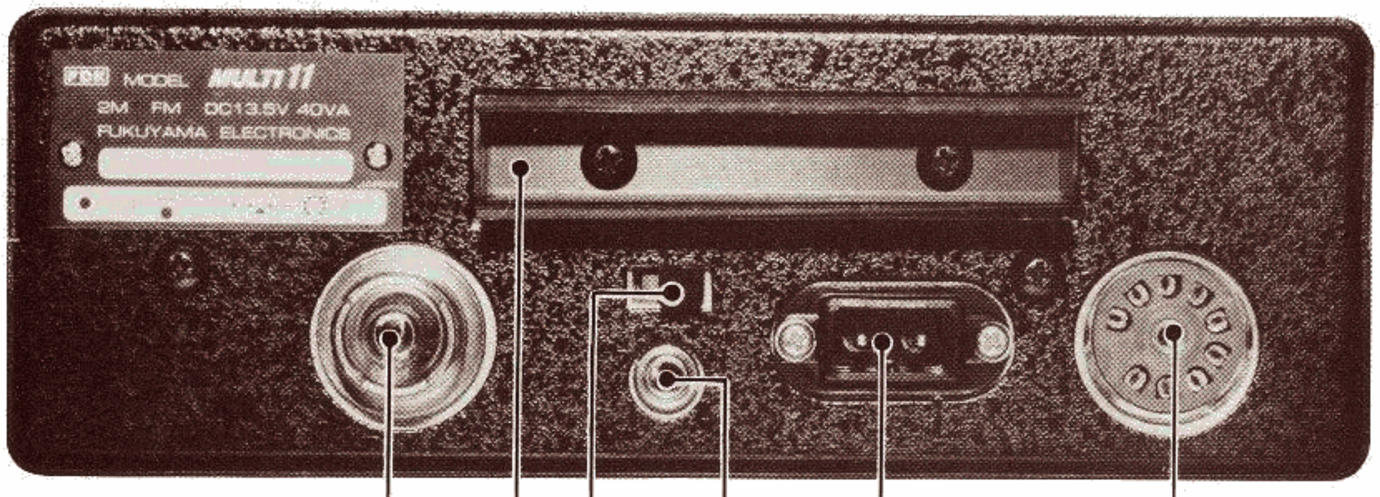
(1)	Microphone	1 pce.
(2)	Angle for car installation	1 set
(3)	Hanger screw for angle	2 pces.
(4)	DC cord	1 length
(5)	Earphone plug (3.5ϕ)	1 pce.
(6)	9 P plug	1 pce.
(7)	Stand	1 pce.
(8)	Fuse (3 A)	1 pce.

PRIOR TO USING

- Do not transmit without connecting the antenna (there is danger for damaging the final stage transistor)
- Avoid using the set at a high location where the temperature is extremely high. Especially, when installing on the car, avoid the hot-air exhaust opening.
- Use the set at the voltage of DC 13.5V (11—14.5V max.). Also the power source must be connected with the correct ⊕⊖ terminal. When connected in reverse, no meter lamp will light nor emit no noise. Moreover, it will not change-over to transmission even if attempted to transmit.




AUTO SCAN
A B C D
2M MULTI 11 FM
PUSH ON/VOL PULL SCAN/SQ
AUTO
MANU
▼SEL
RIT/TONE
POWER
HIGH
MIC
1
2
3
4
5
6
7
8
9
10
11
12


MODEL MULTI 11
2M FM DC13.5V 40VA
FUKUYAMA ELECTRONICS
13
14
15
16
17
18

NAME OF PARTS AND THEIR FUNCTION

1. AUTO SCAN Channel Indicator

The receiving channel is indicated by lighting when AUTO SCAN is in operation.

2. ON/VOL Switch

The power switch goes on when it is pushed in and is disconnected when pushed again. The volume is lowered when turned counter-clockwise and vice versa.

3. SCAN/SQ Switch

Normally for squelching, the noise from the speaker gradually disappear as the switch is turned clock-wise. If the switch is set just at the point of noise disappearance, the set is in receiving condition only when affected.

When the switch knob is drawn forward, the set is changed-over for AUTO SCAN operation. Normally, the set is used at the fixed channel (at AUTO SCAN, the indicator lamp for the fixed channel goes off).

4. AUTO/MANU Change-over Switch

Turn the switch to MANU when the AUTO SCAN operation is to be locked. When the AUTO SCAN channel is to be freely selected, push the switch also to MANU. The channel scanning stops at one of the A. B. C. D channels and is locked there. With each push on the SEL switch, the channel moves on.

[Attention] If operated for transmission at AUTO, the channel sometimes moves to another channel, radiating waves from it. Therefore, be sure to lay down the switch to MANU when the desired station is selected.

5. SEL Switch

Even if set at AUTO and receiving at one of the channels, you can cut-off the channel by pushing the SEL switch once, and the AUTO SCAN commences functioning at the adjacent channel.

6. Fixed Channel No. Indicator

When operating at the fixed channel, the light on the channel indicator shows only the channel actually loaded with the crystal, thus preventing in advance the empty channel selection. Although the Channel Indicator is always lighted at the time of transmission, the light goes off even while transmitting when the final transistor protective circuit is in operation.

7. Fixed Channel Change-over Switch

The set is of multi-channel construction with the 23 channels + exterior VFO by the Fixed Channel Change-over Switch.

8. RIT/TONE SWITCH

The set operates as RIT when the switch is set at its normal position. When the switch is turned to the right with the center directly overhead, the receiving frequency becomes high and vice versa. The frequency varies by about 5 KHz on one side. When the switch is pushed F_2 radio wave radiates and it is convenient for various adjustments for measuring transmitting power output, etc.

When the frequency of the fellow station and the receiving frequency gets out of position, low sensitivity, noise and distortion increases. In such a case, turn the RIT/TONE switch and align tuning accurately. To find the frequency difference, slide the meter change-over switch to the F side and turn the RIT/TONE switch until the meter indicates "F"center. When the meter does not point to center, it is due either to the too great frequency difference of the fellow station or the bad adjustment of crystal of the own station. Please make necessary adjustments by reading the section, "Installing Additional Channels".

[Attention] When radiating the Test Wave, choose the channel not being used, unless confirmed that there is no hindrance against other stations.

9. Power High/Low

The power output on the upper level is 10 W. It is about 1 W at the lower level, which is the most suitable output for the short distance QSO, preventing interference against other stations.

10. MIC JACK

Connect the attached microphone.

If the microphone already on hand is used, check the type and wiring for impedance and connector.

11. MULTI-FUNCTION Meter

This is a multi-function meter.

Normally, as the S/RF meter, it indicates the signal strength of the fellow station when receiving. At transmission, it functions as RF meter, gauging the transmission power output. When the change-over switch, marked "F ↔ S", located on the back panel is slid to F, it functions as the center meter, gauging the frequency difference of the fellow station. (For correction, use the RIT switch.)

When the calibrator switch, located at the bottom of the case, is used simultaneously with the meter set as center meter, difference of transmission frequency at the time of installing additional crystals can also be measured.

(For correction, use the trimmer at the side of the crystal socket.)

12. Transmission Indicator (ON AIR Lamp)

At transmission, the lamp goes on when the press-talk switch on the microphone is pressed.

13. ANT (Antenna) Terminal

Connect the 50Ω antenna for the 2m use attaching to it the M-type connector plug.

[Attention] The transmission of radio wave, without connecting with the antenna, is liable to damage the Final Stage Transistor.

14. Plate for Heat Radiation

This must never be removed as it is for the purpose of increasing the heat-radiation effect of the Final Stage Transistor.

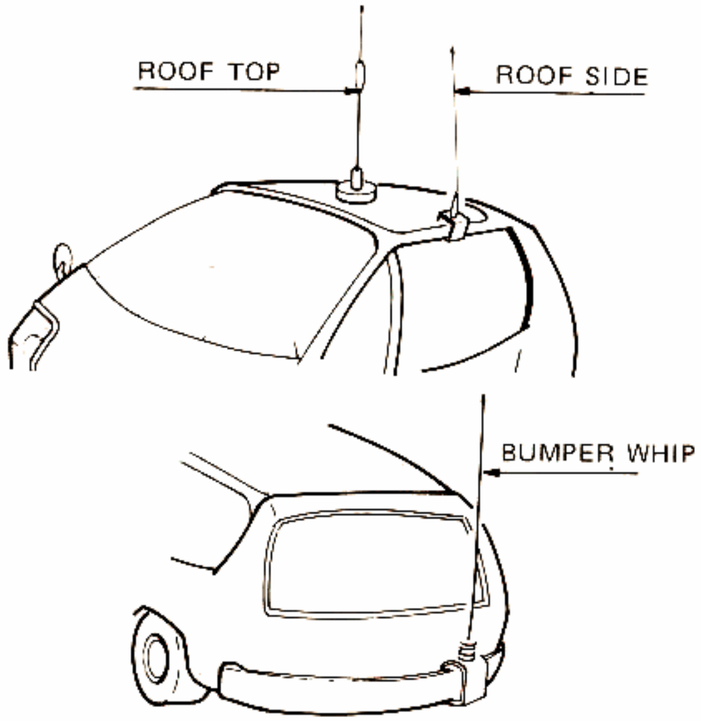


Fig. 3 An example of antenna mounting

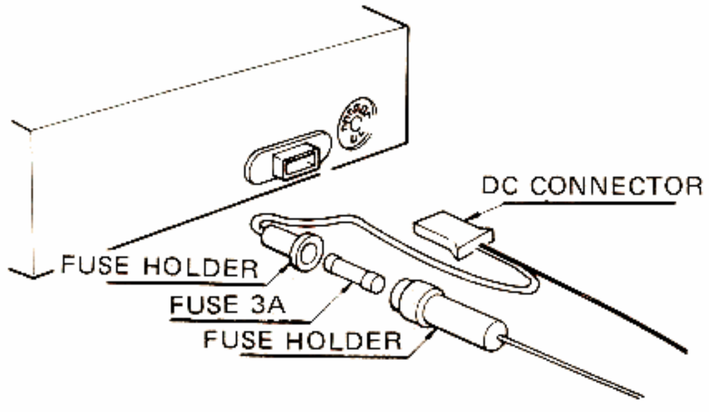


Fig. 4 Power cord connection

6. Coaxial Cable and Fitting M-type Plug

(1) Cut off the covering of the coaxial cable 30 mm from the end.
(2) Pour soldar quickly on the outside cover (shield netting), and cut off about 20 mm from the end.
(3) Insert the coaxial cable into the cover of the M-type plug .
(4) Run the coaxial cable thru the main M-type plug.
(5) Soldar securely both ⊕ and ⊖ sides.
In so doing, be sure that the covering does not burn with the heat.
(6) Cut-off the remaining wire and soldar.
(7) Check the current flow by tester and confirm if there is no short circuit prior to use.

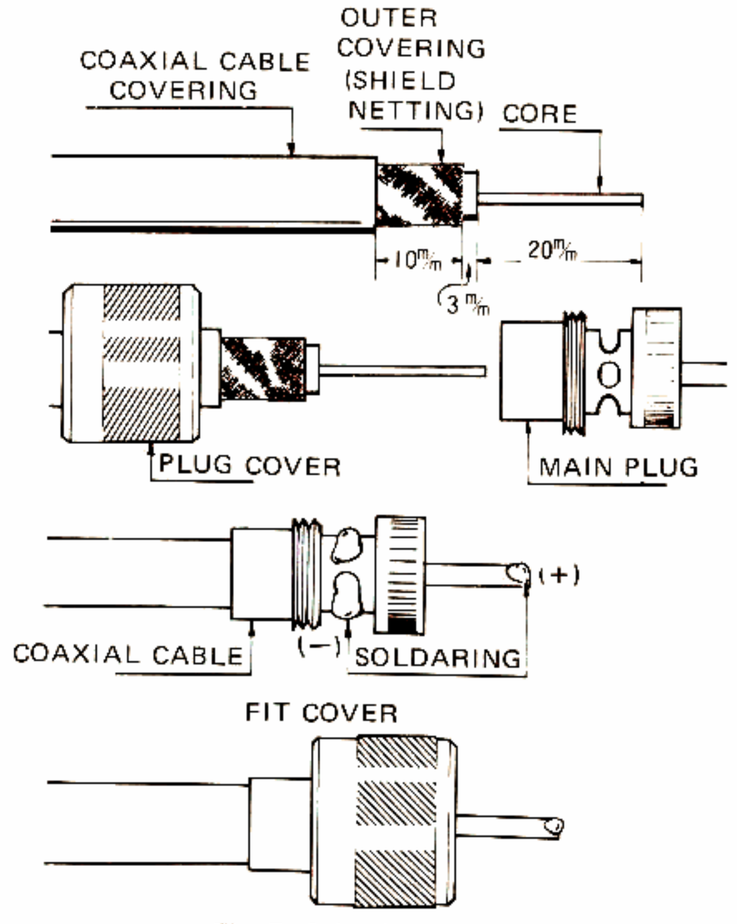


Fig. 5 Soldering M-type plug

■ Operation as Fixed Station

Since MULTI-11 is for DC use only, stabilized power source is required. Use good quality stable power output at 13.5V. 3A minimum.

OPERATION METHOD

[Attention] Be sure to securely connect the antenna cable, power cord and microphone.

■ Reception Method

(1) Put on the power.
(2) Push-in the SCAN/SQ switch and set the fixed channel ready for receiving.
(3) First, turn the channel selector switch to the channel without the crystal (indicator lamp is not lit).
(4) Turn the SCAN/SQ switch fully counter-clockwise.
(5) When the ON/VOL (volume) switch is turned a little by little clockwise, the FM noise is heard. Stop turning at the point where a proper volume is obtained.
(6) Gradually turn the SCAN/SQ switch clockwise and stop turning at the point where noise disappear.
(7) Turn the Fixed Channel Selector to the channel with the crystal.
(8) For AUTO SCAN receiving, set the crystal (for desired frequency) into the crystal socket for each channel from A to D.
   1 Put on the power and make the set ready for a normal operation.
   2 Draw out the SCAN/SQ switch.
   3 Turn the SCAN/SQ switch clockwise and stop turning at the point where noise disappear. It is now ready for scanning.

   [Attention] Turn the SCAN/SQ switch counter-clockwise. When it is at the squelch-off condition (noise appearing position), scanning is stopped by internal noise. Also not that scanning stops when the AUTO/MANU switch is set to MANU.
   4 When operated at AUTO SCAN, scanning stops upon receiving signal by one of the A to D channels. For locking turn the AUTO/MANU switch to MANU. Moreover, for transferring to next channel, push the SEL switch. Scanning is commenced even if the SEL switch is kept on pushing, although the scan-speed is slower than normal.

   Furthermore, when the SEL switch is released, it can also be stopped freely at a desired position.

■ Transmitting Method

(1) The method for transmitting is simple. It is ready for transmitting when the Push-Talk switch on the microphone is pushed, activating the relay (transmitting indicator is lit).
(2) If the transmitting condition is not obtained, sometimes it is due to trouble in the antenna system. Since such cases as the rise in SWR and short circuit in the coaxial cable may be the reason, these possible causes should be removed. Also, attention should be paid to the channel with no crystal setting.
(3) AUTO SCAN transmitting is done similarly. When transmitting with the AUTO/MANU switch being set at AUTO, the channel changes upon receiving. Therefore, for receiving, it should be set to MANU, if the fellow station and frequency is established.

INSTALLING ADDITTIONAL CHANNELS

■ Setting the Crystal

For installing an additional channel, remove the upper cover (2 screws each on both sides). Crystal sockets are arranged in line. Set the crystal for the desired frequency, following the figure No.6. Be careful as the line for transmission and Reception are arranged symmetrically on the right and left. T.XTAL is for transmission and R.XTAL is for Reception. See figure No. 6 for the relation between the socket No. and the channel indication.

Crystals are of HC-25U type and the frequency is as follows:

Transmission: Crystal frequency
= F ÷ 12 (MHz)

Reception: Crystal frequency
= (F − 10.7) ÷ 9 (MHz)

F: desired frequency

■ Method for Adjusting Frequency

- **When there is no counter**

First, adjust the reception frequency.

Set the meter change-over switch located on the back of the set, to F and set the RIT switch to center. When receiving through each channel in this condition, the needle on the meter swings to the middle of the F scale in case the reception frequency matches the transmission frequency of the fellow station. Should frequency be out of position, the needle on the meter swings from the ⊕ to ⊖ side, turn the trimmer, located immediately adjacent to the reception crystal socket and adjust the meter so that the meter needle points to the center on the meter scale. For local stations, it is very FB if there is a station capable of transmitting correct frequency for all channels.

Secondly, at the above condition, turn the CAL switch on the bottom to ON and adjust the crystal on the transmission side. The main point is the same as for the reception, turning the trimmer on the transmission crystal side until the meter needle points to center on the F scale.

- **Method for Correct Calibration on Counter**

[Attention] When transmitting during adjustment, use the terminal wattmeter or false resistance so as not to give interference to other stations.

First set to the transmission condition and correctly measure the transmission frequency on the counter. Should frequency be out of position, correctly match by turning the trimmer for the transmission crystal. The measurement of frequency is to be done by the FM wide.

Next, after setting to reception condition, turn the RIT/TONE switch to center, and slide the meter change-over switch, on the back panel, to the F side. When there is no signal, confirm that the meter indicates center of the F scale.

If the meter does not indicate center, make a fine adjustment on the disc coil DS 2 blue (see page 13) and set the meter indicator to the center of F. Besides, set the CAL switch, located on the bottom, to ON.

At this time, adjust the trimmer of the reception crystal so that the meter indicates the center.

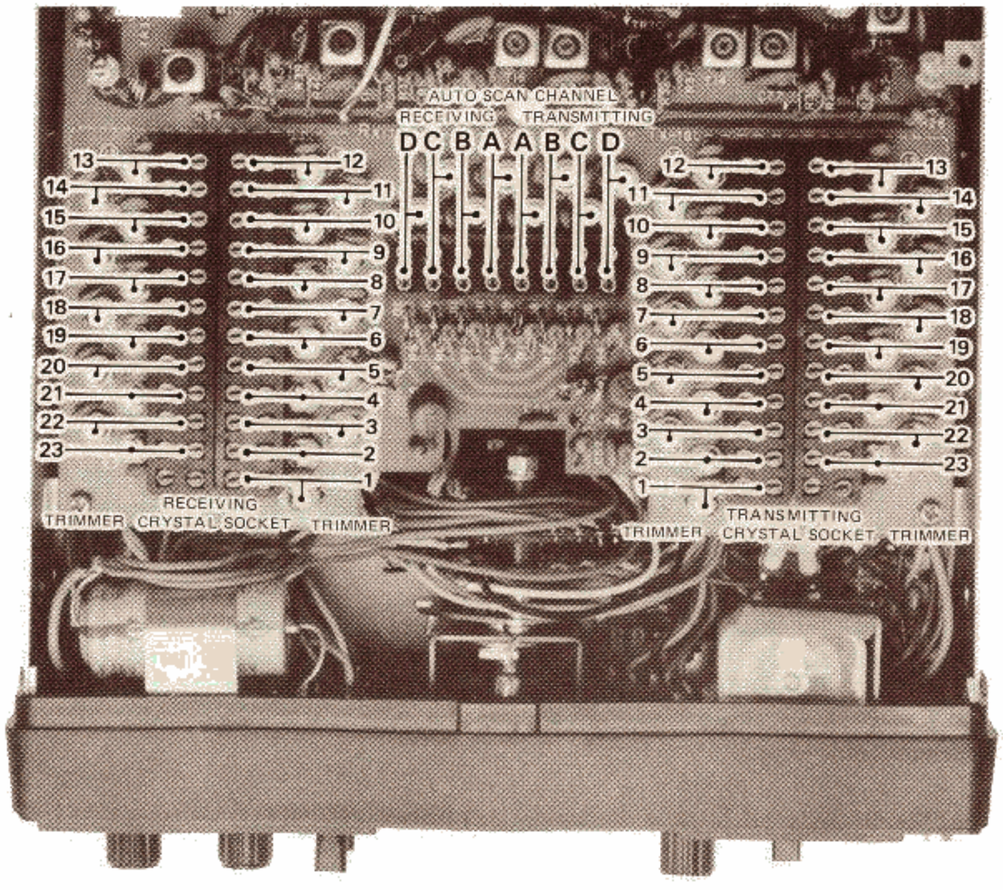


Fig. 6 Crystal socket and trimmer

A = 145.500
B = 145.550
C = 145.250
D =
2 = 145.050 / 195.650
6 = 145.150 / 195.750

EXPLANATION OF THE CIRCUIT

■ The TX Unit

The TR 27 is the transistor for the 12 MHz crystal oscillation. The crystals set in the unit can be changed-over in their function in the 1-23 channel change-over system and SCAN circuit system by the D13 and D14 Diode SW. Through the diode SW located in between TR 27 and TR 28, it can be changed-over to the TR 40 buffer circuit, thus connecting with the VFO terminal.

TR 28 is the passive modulator, modulating Vector composite phase. The modulator consists of TR 35 – TR 37. TR 35 and TR 36 act as differentiation amplifiers. With the additional IDC, they connect to TR 37 integrating amplifier and pour into TR 28 through the split filter.

TR 29 is the tripler, the signal that reached 36 MHz at this point to 144 MHz having passed through the 2 doublers, TR 30 and TR 31. TR 32 and TR 33 are RF amplifiers, the signal here reaching about 0.3 W.

TR 38 is the oscillator for test and F_2, sending the tone of about 1000 Hz through the TR 36 amplifier.

■ The PA Unit

The 144 MHz signal which was 0.3 W by the TX unit reaches about 3 W by the TR 41, and is increased to over 10 W through TR 42.

■ Filter Unit

Transmission and reception are inter-changed through the diode SW, and its efficiency is equivalent to that of the coaxial relay. Harmonics are filtered out. Thus, the 144 MHz signal devoid of spurious radiation is led to the output terminal.

■ RX Unit

TR 13 is the transistor for the local oscillation of the 14 MHz band. The crystals set for TR 13 can be cut-over to the channel change-over and SCAN circuit by the switch in the squelch VR.

Moreover, when VFO is in operation, it can be cut-over to the TR 17 buffer circuit by the diode SW located in between TR 13 and TR 14, and connected with the VFO terminal.

The local osc signal is changed into 134 MHz by TR 14 and TR 15 (triplers), then it is led into TR 3.

The signal received is amplified in detail faithfully by the first stage RF booster of TR 1 and is amplified further by TR 2. Then 144 – 146 MHz only is selected by the resonator and led into the first MIX TR 3. By this TR 3, it is mixed and changed with the local osc signal, resulting in 10.7 MHz. This signal is filtered by the two stage crystal filter selecting only 10.7 MHz, and amplified by the TR 4 IF amplifier with 2 pieces of ceramic filter. This highly selected signal is led to TR 5, and then mixed with the second local osc signal produced by TR 18 and converted to 455 KHz.

The 11.155 MHz output by the second local osc is varied to over ±5 KHz by the variable capacitor 1S 352 and RIT-VR, enabling the correction of receiving frequency.

The signal converted to 455 KHz is further selected by the ceramic filter. By changing the combination of the two filters through the diode SW, the passing band can be discriminated between narrow and wide bands.

The signal passing through the filter is not only amplified by TR 6 – 11 but also is completely limited by the latter stage TR 9, 10 and 11 and the 4 diodes. Then Foster-Sheeley detection is made by the disclimitor 1N 60x2 and becomes the AF signal.

The AF signal passes through TR 12 and amplified to the 3 W voice by IC 3.

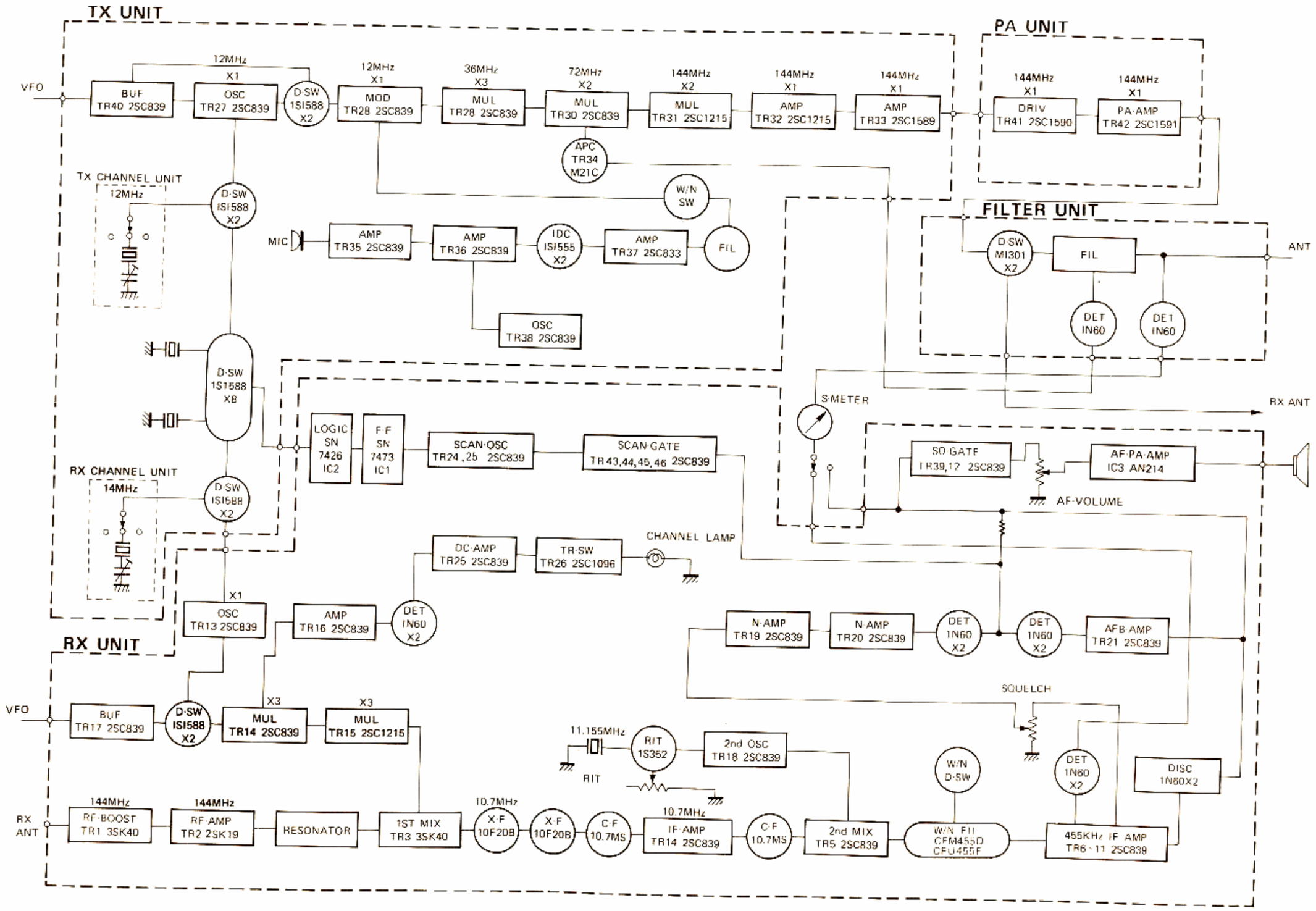
■ Operation of AFB Squelch

The noise signal consisting of AM detected from the TR 11 collector passes through the 10 KHz filter, the signal being amplified by TR 19 and 20. It is detected and form positive voltage. TR 21 is the AFB amplifier which acts as an integration amplifier, picking up the voice part from the FM detection output, transferring it to negative voltage by diode and then mixing with positive voltage. With this voltage, the base voltage of TR39 is controlled and the AF signal is put on or off by TR12 base.

■ Operation of SCAN Circuit

One second scan oscillation by TR 23 and 24 triggers IC 1 and IC 2, thus switching various channels. TR 22 detects negative or positive voltage produced by squelch noise amplifier. TR22 is put to the off position by the negative voltage when there is no signal; and it is put in continuity by the positive voltage when the signal is on, cutting off TR 23 and 24 from operating.

BLOCK DIAGRAM



CAUSES FOR TROUBLE AND ADJUSTING POINTS

■ Receiving Section

(1) Extremely low sensitivity . . . . .
Breaking of core of the coaxial cable and short circuiting
(2) Frequency aberration . . . . .
When specific channel only:
Aberration in adjustment of the transmission trimmer of the first station
When all channels:
Aberration in the disc recoil DS 2 (blue core) (Disconnect the antenna and turn the center meter to 0 at the noise condition.)
(3) No voice is heard
(a) Disconnection in wiring;
Bad contact in the earphone jack
(b) Breakage in the low-frequency amplifier IC 3 AN 214 P
(4) SCAN does not operate
(a) Defective bias for TR 22 (adjust R 131)
(b) Breakage of TR 22

■ Transmitting Section

(1) Extremely low power
Disconnection and short circuit in wiring and coaxial cable
Bad tuning due to deterioration by aging
(2) Frequency aberration
Compensate by the trimmer next to the crystal
(3) When frequency modulation is not understood
(a) Disconnection or short circuit in the microphone cord system
(b) Breakage in the modulation (W)/(N) changeover switch

SPECIFICATIONS

■ General Specifications:

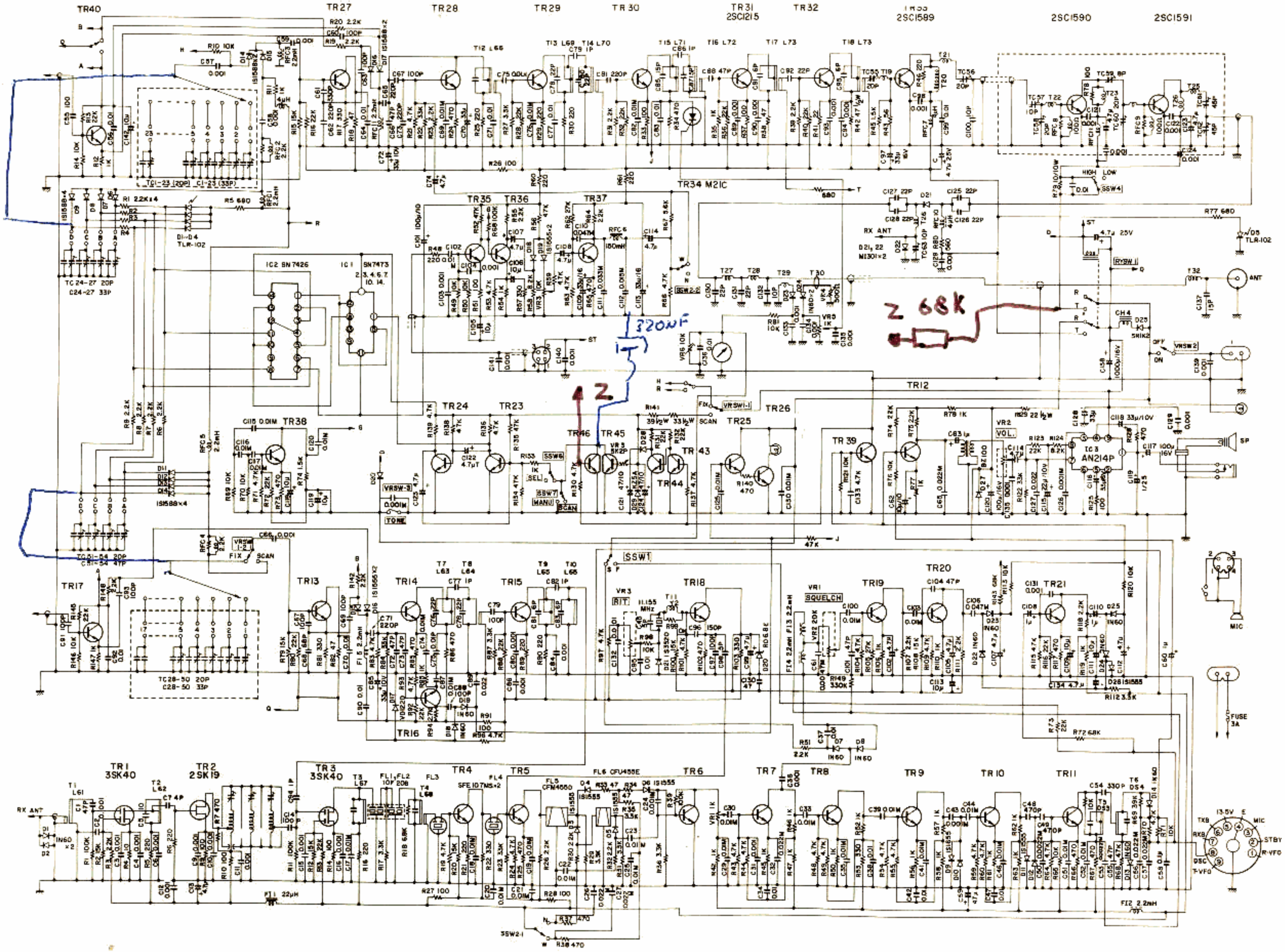
Frequency range for transmission and reception:
144.0 – 146.0 MHz or
146.0 – 148.0 MHz
No. of channels: 23 channels + 4 SCAN + VFO channel
Selection method: Fixed and VFO channel
Rotary switch selection
SCAN channel . . . Automatic and manual
SCAN Speed: 4 channel/second
Voltage at Power Source:
DC 13.5V operation voltage
11 – 15V minus grounding
Current consumption:
At transmission (Hi) about 2.5A
(Low) about 1.3A
At reception (Max.) about 0.6A
(No Signal) about 0.3A
Semiconductor used:
Tr 41, FET 3, IC 3, D 54, SCR 1
Measurement: Width 163 mm
Height 56 mm
Depth 220 mm (except projections)
Weight: about 2 kg

■ Transmitting Section

Wave type: F3
Transmitting output: Hi 10 W
Low about 1 W
Modulation method: Vector synthetic phase modulation
Maximum frequency deviation:
Wide 15 KHz
Narrow 5 KHz
No. of doubling: 12
Basic oscillation frequency:
12 MHz
Unnecessary radiation strength:
less than – 60 dB
Antenna Impedance: 50 Ω
Microphone: Dynamic type 500 Ω

■ Receiving Section

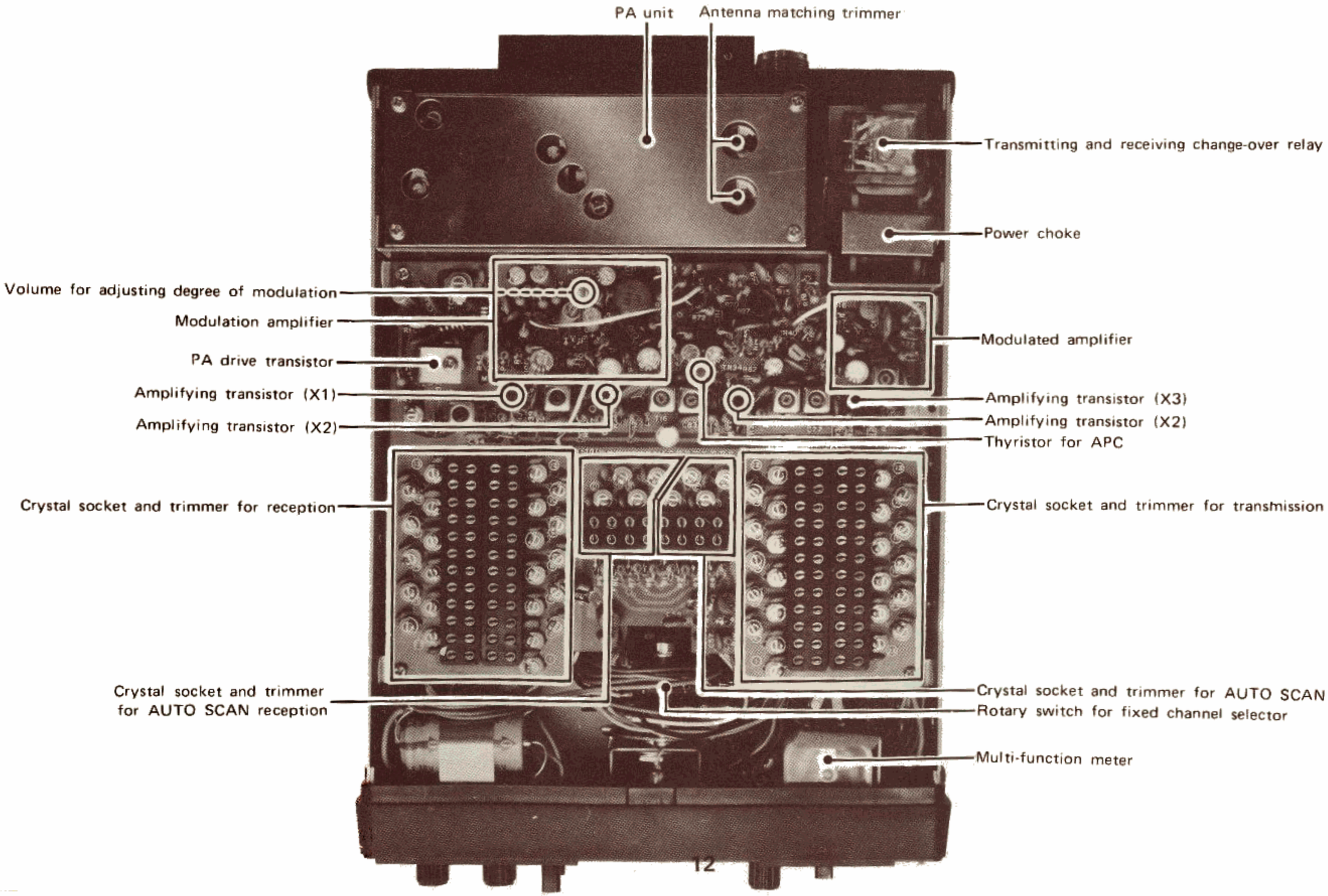
Wave type: F_3
Receiving method: Double super heterodyne
Intermediate frequency:
No. 1 IF 10.7 MHz
No. 2 IF 455 KHz
Sensitivity: Less than 0.5μV (20dB NQ)
Squelch sensitivity: Less than 0.5μV
Selectivity: Wide 14 KHz Min. (–6 dB)
20 KHz max. (–60 dB)
Narrow 7 KHz Min. (–6 dB)
12 KHz max. (–60 dB)
Image ratio: 60 dB Min.
Receiving spurious: 60 dB Min.
No. of doubling the oscillation of the 1st station:
9
Low frequency output:
3 W (10% staggering at 4Ω load)



• NO MARKED TRANSISTORS ARE 2SC839.

* Schematic Diagram and Specifications are subject to change without prior notice.

ARRANGEMENT OF VARIOUS PARTS



ARRENGEMENT OF VARIOUS PARTS