

KENWOOD

SERVICE MANUAL

MODEL TR-3200



UHF TRANSCEIVER

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SPECIFICATIONS

GENERAL

Semiconductors:	Transistor 31 IC 4 Diode 18
Frequency Range:	TX 431.0 ~ 433.5 MHz RX 431.0 ~ 439.5 MHz
Transmit/Receive Channels (built-in):	Receive 438.650 MHz 438.900 MHz 432.000 MHz Transmit 431.050 MHz 431.300 MHz 432.000 MHz
Operating Temperature:	-20°C ~ + 50°C
Standard Operating Voltage:	DC 13V
Operating Voltage Range:	DC 9.6V ~ 15.6V
Grounding System:	Negative ground
Antenna Impedance:	50Ω
Power Consumption:	Receive (no signal). Approx. 50 mA (13.0V) Transmit (HI). Approx. 750 mA (13.0V) Transmit (LOW). Approx. 550 mA (13.0V)
Dimensions:	135 (W) x 58 (H) x 191 (D) mm 5-5/16 (W) x 2-9/32 (H) x 7-33/64 (D) inch
Weight:	Approx. 1.6 kg, 3.52 lbs. (Ni-Cd battery cells (10) included)

TRANSMITTER SECTION

Transmit Frequency:	431.0 ~ 433.5 MHz (12 channels)
Type of Wave:	F3
Rated Input:	11.5V, 4W (HI)
RF Output Power:	2W (HI) or approx. 0.4W (LOW)
Modulation:	Variable reactance phase modulation
Maximum Frequency Deviation:	±7.5 kHz
Multiplication:	18 times
Spurious Emission:	Less than -60 dB
Microphone:	Dynamic type with press-to-talk switch, 500Ω

RECEIVER SECTION:

Receive Frequency:	431.0 ~ 439.5 MHz (12 channels)
Type of Wave:	F3
Circuitry:	Double superheterodyne
Intermediate Frequency:	1st IF 10.7 MHz 2nd IF 455 kHz
Squelch Sensitivity:	More than 0.5 μV
Sensitivity:	431.0 ~ 438.5 MHz Better than 20 dB S/N at 1 μV input Others: Better than 20 dB S/N at 1.4 μV input More than 16 kHz (at -6 dB) Less than 32 kHz (at -60 dB)
Pass-band Width:	
Selectivity:	
Audio Output:	More than 0.7W (at 10% distortion and 8Ω load)

CIRCUIT DESCRIPTION

GENERAL

TR-3200 is an all solid state 430 MHz band FM transceiver for amateur radio stations, which is operated in crystal controlled twelve channels in both transmit and receive circuits. For repeater operation, a tone oscillator is incorporated.

Transmitting power output can be selected in either High (2 watts) or Low (0.4 watts) by pressing the Hi-Low switch on the panel.

TR-3200 block diagram including 31 transistors, 4 ICs and 18 diodes is shown on page 4.

The following functional units are contained.

Units:

1. RX unit (X55-1100-61)
2. TX unit (X56-1180-00)
3. Filter unit (X51-1120-00)
4. Tone unit (X52-1070-60)

In addition, various auxiliary circuits and terminals are provided in both transmit and receive section to give maximum performance and reliable operation.

Auxiliary Circuits:

1. S/Rf meter
2. Battery checker
3. Switching of transmitter output power, HIGH or LOW
4. Aux. terminal (Center meter terminal)
5. Switching circuit
6. Tone oscillator

Auxiliary Terminals:

- | | |
|--------------|--|
| 1. WHIP ANT. | Connecting the appended whip antenna |
| 2. ANT. | Connecting an external antenna |
| 3. MIC | Connecting a microphone |
| 4. AUX. | Connecting the remote cable |
| 5. EXT DC | Connecting an external power supply or charger |
| 6. EXT SP | Connecting an external loud speaker system |

1. RECEIVER CIRCUIT

Received signal from the antenna is led to a 2 steps tuned circuit that contributes to advance of the intermodulation characteristic rejecting unwanted signal or noise. Then, the received signal is amplified by a common base RF amplifier Q1, and fed through a double tuned circuit to the first mixer Q2.

The first mixer Q2 generates the first IF of 10.7 MHz, mixing the signal amplified by Q1 and the 420 MHz band local oscillator signal which is produced by multiplying 35 MHz band crystal oscillator. The first IF of 10.7 MHz is amplified by Q6 (IC TA-7045M) after passing the 2 steps X'tal filter and coupled to the base of the second mixer Q7.

The second mixer Q7 produces the second IF of 455 kHz, mixing the amplified first IF of 10.7 MHz and the second local oscillator signal of 10.245 MHz. The second IF circuit containing a ceramic filter shows the selectivity characteristic of 32 kHz or less at -50 dB.

Then the second IF signal is amplified by Q10 ~ 13 and the limiter amplifiers of Q14, 15.

This signal is FM detected and amplified by the AF circuitry to drive the loud speaker.

2. TRANSMITTER CIRCUIT

The 24 MHz band crystal selected by the channel selector is oscillated by Q2 and is fed to the buffer Q3 in order to keep the frequency stability.

The signal from Q3 is injected to the modulation circuit as a carrier and is frequency modulated by the AF signal amplified.

The output of the modulation circuit is fed through the buffer Q4 to the multiplier Q5, converting to 72 MHz tripled.

For repeater operation, depressing the TONE SW button excite the tone oscillator, resulting in injection of 1750 Hz signal into the modulation circuits. In order to get a good spurious characteristic, spurious responses should be sufficiently reduced preceding the B.P.F. Moreover, the driving level of each amplifier and the tuning characteristic of multipliers etc. should be fully regarded.

In TR-3200, considering the passband the double tuned circuit is provided for the multipliers. Especially, for the tripler converting the signal frequency from 24 MHz to 72 MHz, a triple tuned circuit is employed, resulting to keep off the generation of spurious responses.

The signal multiplied to 72 MHz in this arrangement is doubled to 144 MHz by Q6 and fed to the RF amplifier Q8. Furthermore, the output signal of Q8 is tripled to 432 MHz by Q9.

The 432 MHz signal is performed as follows:

CIRCUIT DESCRIPTION

24 MHz (Crystal frequency) X 3 X 2 X 3
= 432 MHz (18 multiplication)

and RF amplified by the driver Q10. The final stage of Q11 power amplifies this signal to produce the rating output power.

In the purpose of stable operation, great care should be taken with regard to selection of the final stage transistor, considering its rating especially breakdown or a safety operation area.

TR-3200 is equipped with a 2SC1724 for reliable operation. Its rating is shown below.

The collector voltage of the drive and the final stages for DC bias is changed by switching the HIGH-LOW switch.

In accordance with this switching, RF output power is also alternated to 4 Watts or 2 Watts.

The output of the final stage is fed through the RF switching circuit D1, D2 to the B.P.F. that furthermore reduces undesired spurious responses and propagated from the antenna as electromagnetic radio waves.

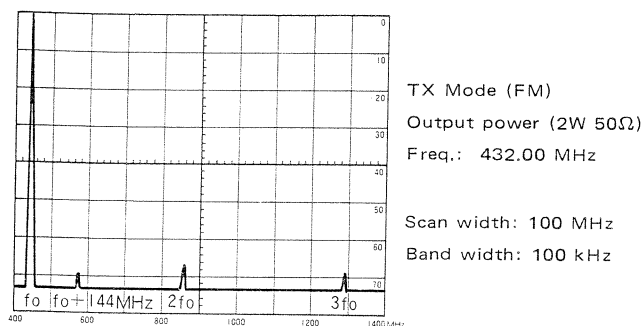
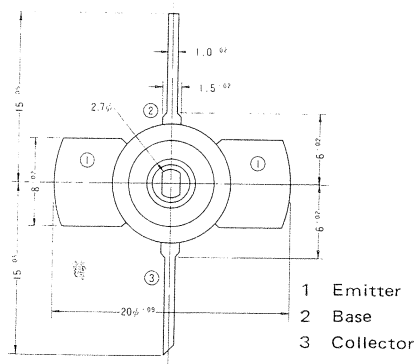


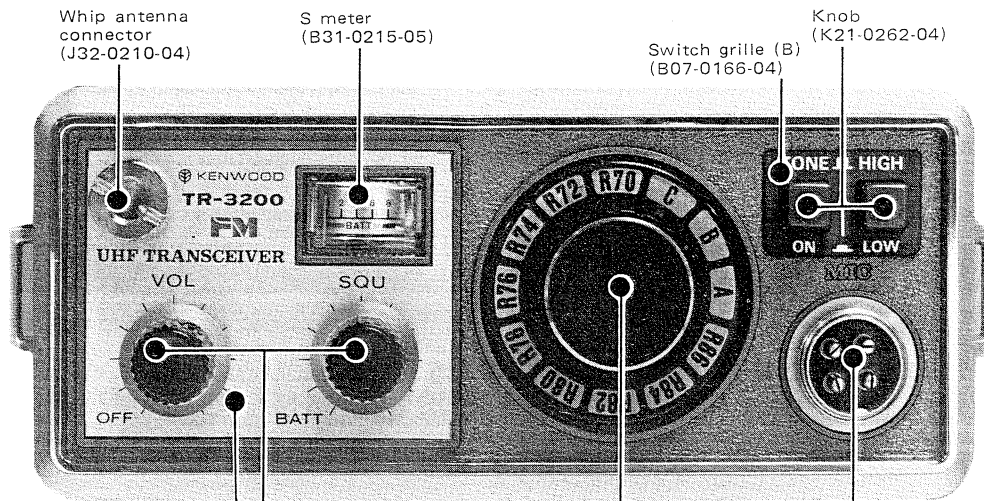
Fig. 1 An Example of Spurious Response

FINAL TRANSISTOR RATINGS

Model	2SC1724							
Application	UHF Power transistor							
Construction	NPN							
Ratings ($T_a = 25^\circ\text{C}$)	V_{CBO}	V_{CEO}	V_{EBO}	I_C	I_E	P_C	T_j	T_{stg}
	35	17	3.5	0.8	-0.8	7.5	175	-65 ~ 175
	V	V	V	A	A	W	$^\circ\text{C}$	$^\circ\text{C}$
Temperature	$T_a = 25 \pm 1.5^\circ\text{C}$							



PARTS ALIGNMENT



Dressing panel (A21-0238-04)

Knob (K21-0297-04)

Knob (K23-0224-03)

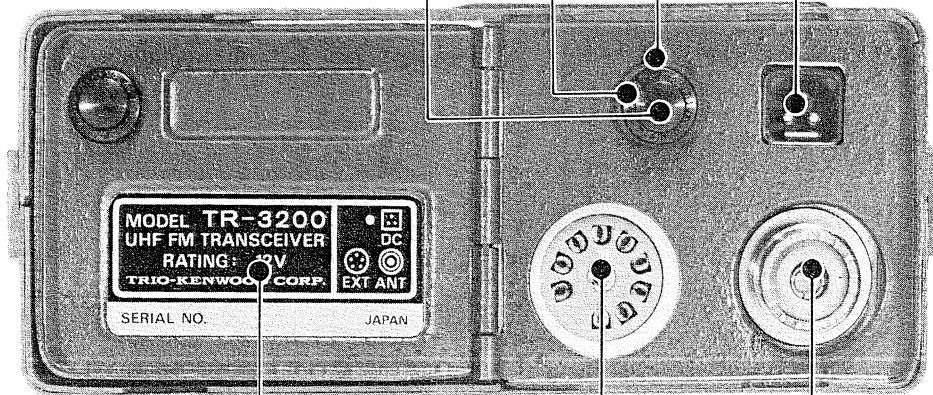
4P mic jack (E06-0403-05)

Grommet (J59-0001-05)

Power jack (3P) (E08-0304-05)

Plunger (J59-0002-05)

Spacer (J30-0061-04)

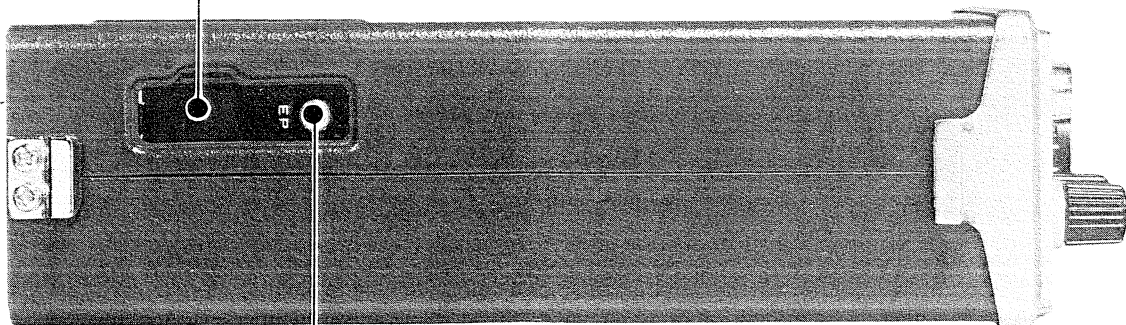


Model name plate (B40-1264-04)

9P socket (jack) (E01-0903-05)

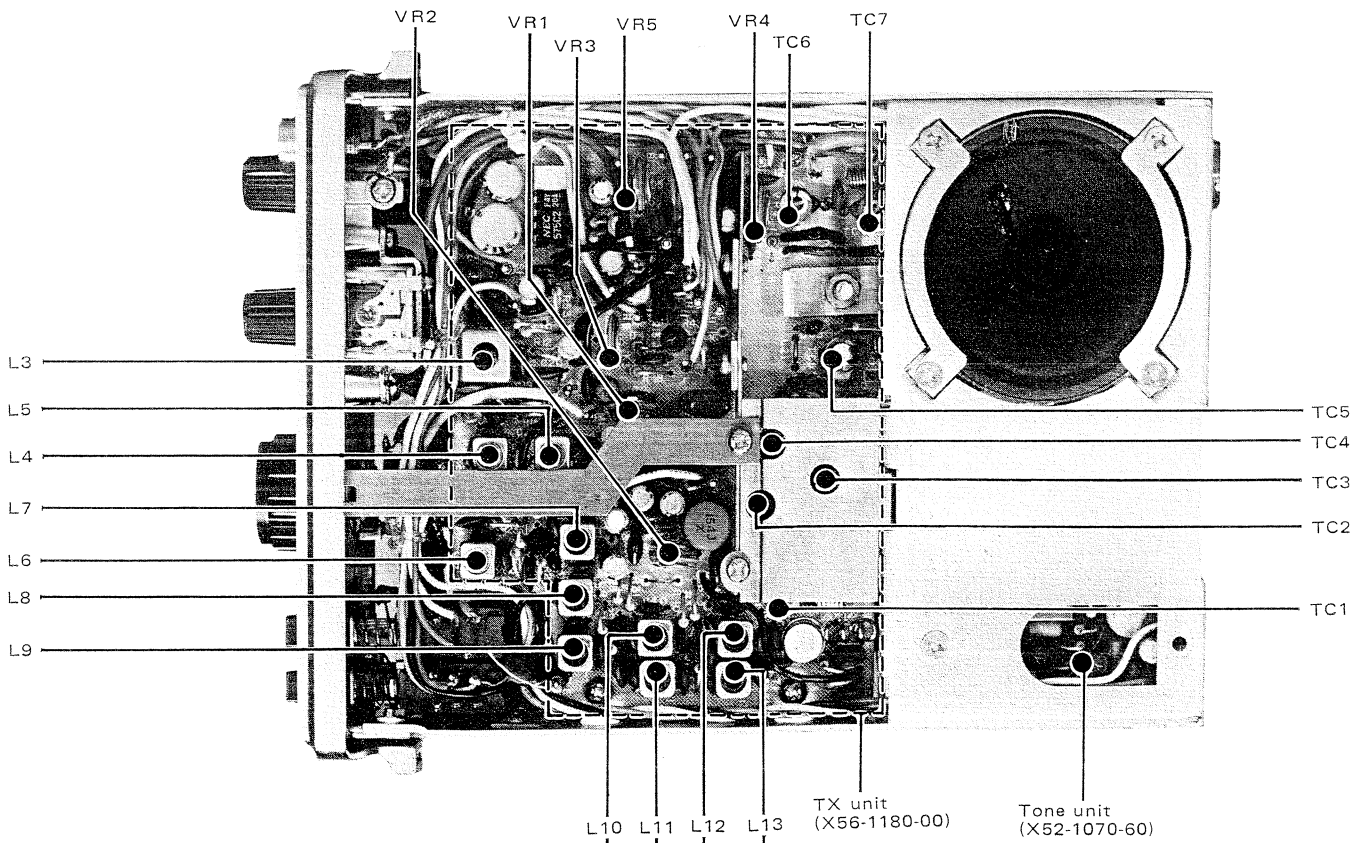
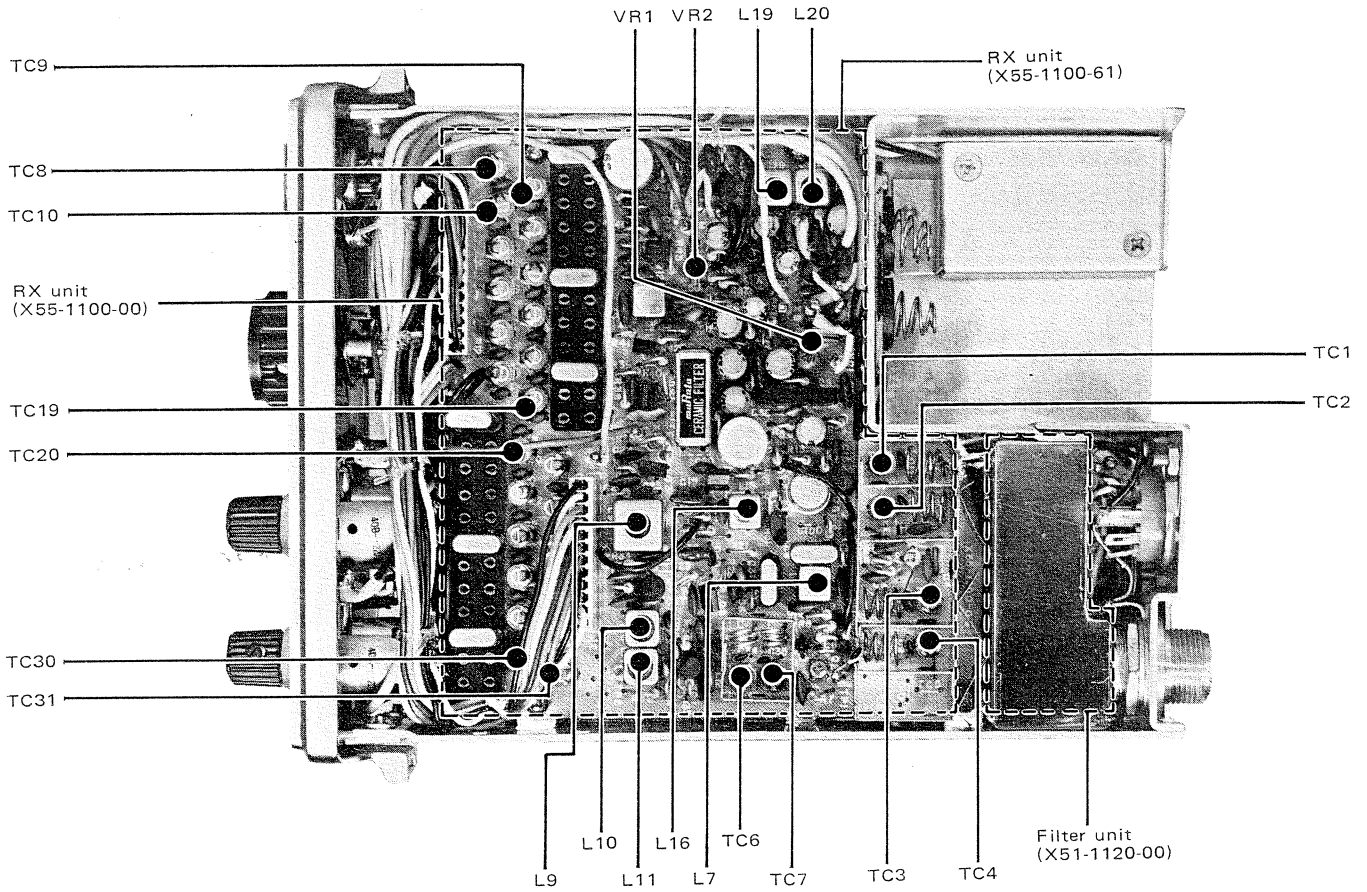
M type connector (E04-0102-05)

EP sticker (B42-0601-14)



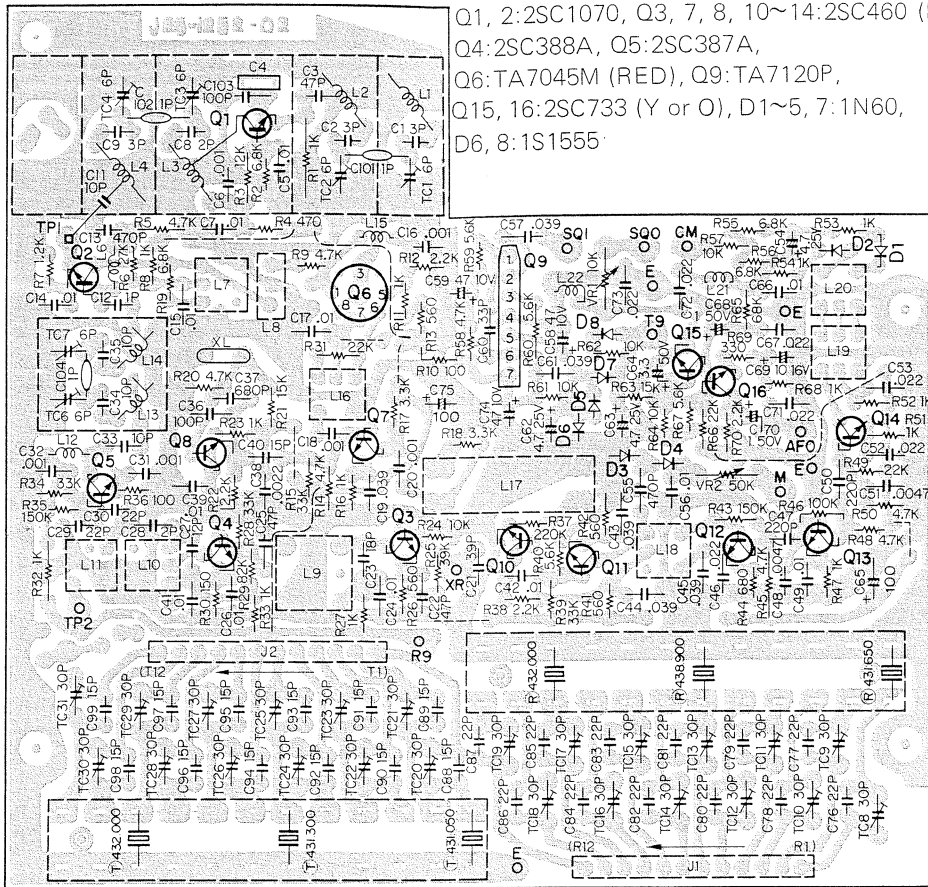
Earphone jack (E11-0003-15)

PARTS ALIGNMENT

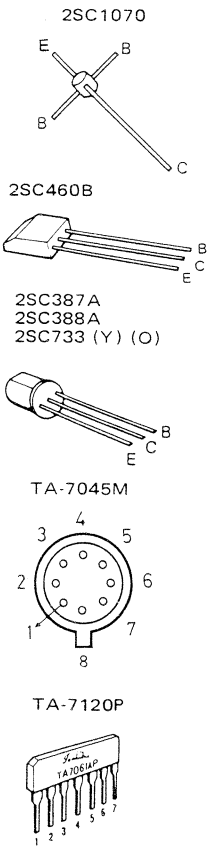


PC BOARD

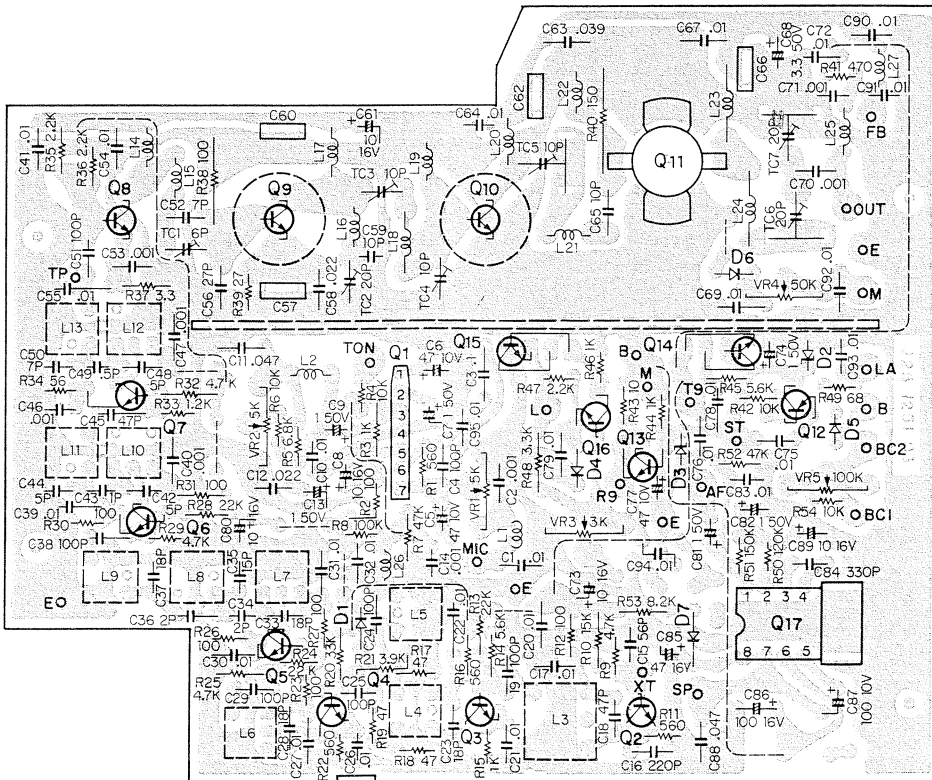
RX UNIT
(X55-1100-61)



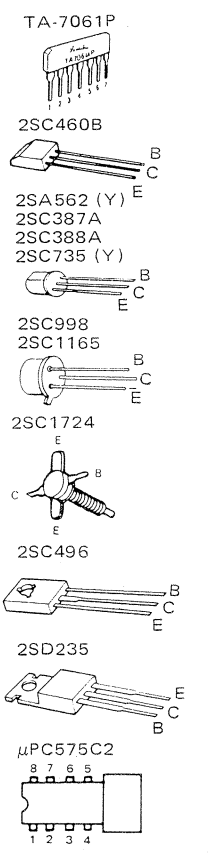
Q1, 2:2SC1070, Q3, 7, 8, 10~14:2SC460 (B),
Q4:2SC388A, Q5:2SC387A,
Q6:TA7045M (RED), Q9:TA7120P,
Q15, 16:2SC733 (Y or O), D1~5, 7:1N60,
D6, 8:1S1555



TX UNIT
(X56-1180-00)

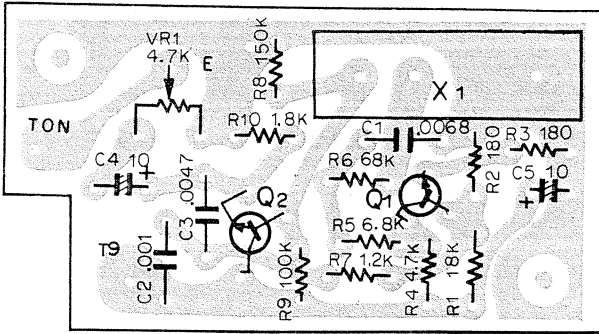


Q1:TA7061AP, Q2~4:2SC460 (B), Q5~7:2SC388A, Q8:2SC998, Q9, 10:2SC1165,
Q11:2SC1724, Q12:2SA562 (Y), Q13:2SC496 (Y or O), Q14, 15:2SD235 (Y or O),
Q16:2SC735 (Y), Q17:μPC575C2, D1:1S1658-1, D2, 3:WZ-090, D4, 5, 7, 8:1S1555, D6:1N60

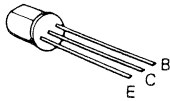


PC BOARD/PACKING/PARTS LIST

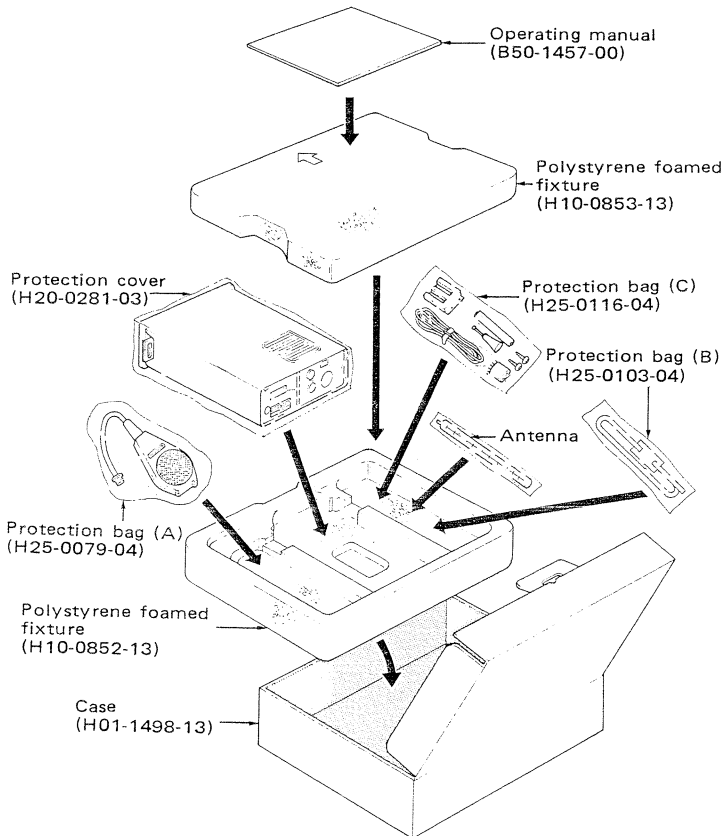
TONE UNIT (X52-1070-60)



Q1, 2:2SC733 (Y)



PACKING



Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C101	CK45F1H103Z	Ceramic 0.01 μ F +80%, -20%	
C102	CK45D1H102M	Ceramic 0.001 μ F \pm 20%	
C103	CC45SL1H470K	Ceramic 47pF \pm 10%	
C104	CK45F1H103Z	Ceramic 0.01 μ F +80%, -20%	
C106	CK45F1H103Z	Ceramic 0.01 μ F +80%, -20%	
C107	CC45SL1H101K	Ceramic 100pF \pm 10%	
SEMICONDUCTOR			
D101	V11-0219-05	Diode V06B	
POTENTIOMETER			
VR1u1	R02-2010-15	(AF gain) 5k Ω (A) with switch	
VR102	R02-2011-15	(Squelch) 5k Ω (B) with switch	
CRYSTAL			
-	L77-0477-05	(T. 431.05 MHz)	
-	L77-0242-05	(T. 432.00 MHz)	
-	L77-0478-05	(T. 431.30 MHz)	
-	L77-0479-05	(R. 438.05 MHz)	
-	L77-0246-05	(R. 432.00 MHz)	
-	L77-0480-05	(R. 438.90 MHz)	
SWITCH			
S1a~b	S01-2018-05	Rotary switch	
S4	S40-2066-05	Push switch	
S5	S40-2059-05	Push switch	
MICELLANEOUS			
-	A01-0268-12	Case	
-	A10-0459-12	Chassis	
-	A20-0962-05	Panel	
-	A21-0238-04	Dressing panel	
-	B05-0123-04	Speaker grille cloth	
-	B07-0166-04	Switch grille (B)	
-	B19-0182-04	Dial slit	
-	B19-0185-04	Color filter	
-	B31-0215-05	Ω meter	
-	B40-1264-04	Model name plate	
-	B42-0601-14	EP sticker	
-	B42-0610-14	Caution sticker	
-	B50-1457-00	Operating manual	
-	E01-0903-05	9P socket (jack)	
-	E04-0102-05	M type connector	
-	E05-0901-05	9P socket (plug)	
-	E06-0403-05	4P mic jack	
-	E08-0304-05	Power jack (3P)	
-	E11-0003-15	Earphone jack	
-	E12-0001-05	Phone plug	
-	E20-0430-03	Terminal (4P)	
-	E23-0015-04	Earth lug x 4	
-	E23-0043-04	Antenna-earth lug (for mic jack)	
-	E23-0088-04	Antenna-earth lug (for M type connector)	
-	E30-0220-05	Power plug with lead (3P)	
-	E30-0508-05	Connector with lead (12P, RX)	
-	E30-0512-05	Connector with lead (12P, TX)	
-	F10-0377-04	Filter cover	
-	F10-0381-04	Shield plate (A) (TX multiplier)	
-	F10-0382-04	Shield plate (B) (RX shield case)	
-	F10-0388-04	Shield plate (C) (TX)	
-	F20-0106-04	Insulating plate (A)	
-	F20-0107-04	Insulating plate (B)	
-	F20-0108-04	Insulating plate (C)	
-	F20-0109-04	Cover	
-	G01-0323-13	Spring absorber	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
—	G11-0008-04	Meter cushion	
—	G53-0013-04	Ring (water tight)	
—	G53-0014-04	Meter packing	
—	H01-1498-13	Case	
—	H03-0484-14	Case (external) x 1/6	
—	H10-0852-13	Polystyrene foamed fixture	
—	H10-0853-13	Polystyrene foamed fixture	
—	H20-0281-03	Protection cover	
—	H25-0079-04	Protection bag (A)	
—	H25-0103-04	Protection bag (B)	
—	H25-0116-04	Protection bag (C)	
—	J19-0461-05	Battery case (A)	
—	J19-0462-05	Battery case (B)	
—	J19-0464-04	Cover stopper x 2	
—	J20-0311-04	PC board stopper	
—	J20-0319-14	Hook fitting	
—	J20-0321-04	Mount for relay	
—	J21-0706-04	Meter retainer	
—	J21-1380-04	Speaker stopper	
—	J25-1246-04	PC board (switch)	
—	J30-0061-04	Spacer	
—	J31-0134-04	Collar	
—	J32-0210-04	Whip antenna connector	
—	J59-0001-05	Grommet x 2	
—	J59-0002-05	Plunger x 2	
—	J61-0019-05	Vinyl tigh x 6	
—	J61-0055-05	Shoulder belt	
—	K21-0262-04	Knob (push) x 2	
—	K21-0297-04	Knob (AF, SQUELCH) x 2	
—	K23-0224-03	Knob (channel selector)	
—	N14-0104-04	Nut (antenna terminal)	
—	N19-0228-04	Nylon washer (knob)	
—	N19-0231-14	Insulation ring x 2	
—	N87-3006-46	Tap-tight screw x 8	
—	N88-3006-46	Pan-head tap-tight screw x 4	
—	T02-0006-15	Speaker	
—	T90-0078-15	Antenna (5/8λ whip)	
—	T91-0033-05	Microphone	
—	W09-0002-05	Dummy battery	
—	X51-1120-00	Filter unit	
—	X52-1070-60	Tone unit	
—	X55-1100-61	RX unit	
—	X56-1180-00	TX unit	

FILTER (X51-1120-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CK45D1H102M	Ceramic 0.001μF ±20%	
C2	CC45CH1H120J	Ceramic 12pF ±5%	
C3	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C4, 5	CC45CH1H020C	Ceramic 2pF ±0.25pF	
C6	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C7	CC45CH1H050D	Ceramic 5pF ±0.5pF	
C8	CC45CH1H030C	Ceramic 3pF ±0.25pF	
SEMICONDUCTOR			
D1, 2	V11-0255-05	Diode M301 x 2	
COIL			
L1	L34-0504-05	Air core coil (3T)	

Ref. No.	Parts No.	Description	Re- marks
L2	L34-0450-05	Air core coil (1T)	
L3	L34-0503-05	Air core coil (2T)	
L4	L34-0452-05	Air core coil (A) (6T)	
MISCELLANEOUS			
—	E23-0055-05	Hermetic seal x 7	
—	F11-0222-04	Filter case	

TONE UNIT (X52-1070-60)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CQ93M1H682K	Mylar 0.0068μF ±10%	
C2	CQ93M1H102K	Mylar 0.001μF ±10%	
C3	CQ93M1H472K	Mylar 0.0047μF ±10%	
C4, 5	CE04W1C100(RL)	Electrolytic 10μF 16WV	
RESISTOR			
R1	PD14CY2B154J	Carbon 150kΩ ±5%	
R2	PD14CY2B183J	Carbon 18kΩ ±5%	
R3	PD14CY2B181J	Carbon 180Ω ±5%	
R4	PD14CY2B472J	Carbon 4.7kΩ ±5%	
R5	PD14CY2B682J	Carbon 6.8kΩ ±5%	
R6	PD14CY2B683J	Carbon 68kΩ ±5%	
R7	PD14CY2B122J	Carbon 1.2kΩ ±5%	
R8	PD14CY2B154J	Carbon 150kΩ ±5%	
R9	PD14CY2B104J	Carbon 100kΩ ±5%	
R10	PD14CY2B182J	Carbon 1.8kΩ ±5%	
SEMICONDUCTOR			
Q1, 2	V03-0123-05	Transistor 2SC733 (Y)	
POTENTIOMETER			
VR1	R12-1028-05	4.7kΩ (B)	
X1	L79-0028-05	Tuning fork oscillator (1750 HZ)	

RX (X55-1100-61)

Ref. No.	Parts No.	Description	Re- marks
C1, 2	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C3	CC45SL1H470J	Ceramic 47pF ±5%	
C4	C90-0215-05	Ceramic 0.001μF	
C5	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
C6	CK45D1H102M	Ceramic 0.001μF ±20%	
C7	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
C8	CC45CH1H020C	Ceramic 2pF ±0.25pF	
C9	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C11	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C12	CC45CH1H010C	Ceramic 1pF ±0.25pF	
C13	CK45B1H471K	Ceramic 470pF ±10%	
C14, 15	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
C16	CQ92M1H102K	Mylar 0.001μF ±10%	
C17	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
C18	CK45D1H102M	Ceramic 0.001μF ±20%	
C19	CQ92M1H393K	Mylar 0.039μF ±10%	
C20	CK45D1H102M	Ceramic 0.001μF ±20%	
C21	CC45CH1H390J	Ceramic 39pF ±5%	
C22	CC45CH1H470J	Ceramic 47pF ±5%	
C23	CC45TH1H180J	Ceramic 18pF ±5%	
C24	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
C25	CC45CH1H470J	Ceramic 47pF ±5%	
C26	CK45F1H103Z	Ceramic 0.01μF ±80%, -20%	
C27	CC45RH1H120J	Ceramic 12pF ±5%	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
C28	CC45CH1H020C	Ceramic 2pF ±0.25pF	
C29, 30	CC45RH1H220J	Ceramic 22pF ±5%	
C31, 32	CK45D1H102M	Ceramic 0.001μF ±20%	
C33~35	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C36	CC45SL1H101K	Ceramic 100pF ±10%	
C37	CK45B1H681K	Ceramic 680pF ±10%	
C38	CQ92M1H223K	Mylar 0.022μF ±10%	
C39	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
C40	CC45CH1H150J	Ceramic 15pF ±5%	
C41	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
C42	CQ92M1H103K	Mylar 0.01μF ±10%	
C43~45	CQ92M1H393K	Mylar 0.039μF ±10%	
C46	CQ92M1H223K	Mylar 0.022μF ±10%	
C47	CC45SL1H221K	Ceramic 220pF ±10%	
C48	CQ92M1H472K	Mylar 0.0047μF ±10%	
C49	CQ92M1H103K	Mylar 0.01μF ±10%	
C50	CC45SL1H221K	Ceramic 220pF ±10%	
C51	CQ92M1H472K	Mylar 0.0047μF ±10%	
C52, 53	CQ92M1H223K	Mylar 0.022μF ±10%	
C54	CE04W1E4R7(RL)	Electrolytic 4.7μF 25WV	
C55	CK45B1H471K	Ceramic 470pF ±10%	
C56	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
C57	CQ92M1H393K	Mylar 0.039μF ±10%	
C58, 59	CE04W1A470(RL)	Electrolytic 47μF 10WV	
C60	CC45SL1H330J	Ceramic 33pF ±5%	
C61	CQ92M1H393K	Mylar 0.039μF ±10%	
C62, 63	CE04W1E4R7(RL)	Electrolytic 4.7μF 25WV	
C64	CE04W1H3R3(RL)	Electrolytic 3.3μF 50WV	
C65	C90-0312-05	Electrolytic 100μF 50WV	
C66	CQ92M1H103K	Mylar 0.01μF ±10%	
C67	CQ92M1H223K	Mylar 0.022μF ±10%	
C68	CE04W1H010(RL)	Electrolytic 1μF 50WV	
C69	CE04W1C100(RL)	Electrolytic 10μF 16WV	
C70	CE04W1H010(RL)	Electrolytic 1μF 50WV	
C71~73	CQ92M1H223K	Mylar 0.022μF ±10%	
C74	CE04W1A470(RL)	Electrolytic 47μF 10WV	
C75	C90-0312-05	Electrolytic 100μF	
C76~87	CC45SL1H220J	Ceramic 22pF ±5%	
C88~99	CC45SL1H150J	Ceramic 15pF ±5%	
C100	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C101,102	CC45CH1H010C	Ceramic 1pF ±0.25pF	
C103	CC45SL1H101K	Ceramic 100pF ±10%	
C104	CC45CH1H010C	Ceramic 1pF ±0.25pF	

RESISTOR

R1	PD14BY2B102J	Carbon 1kΩ ±5% 1/8W	
R2	PD14CY2B682J	Carbon 6.8kΩ ±5% 1/8W	
R3	PD14CY2B123J	Carbon 12kΩ ±5% 1/8W	
R4	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
R5	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R6	PD14CY2B273J	Carbon 27kΩ ±5% 1/8W	
R7	PD14CY2B122J	Carbon 1.2kΩ ±5% 1/8W	
R8	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R9	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R10	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R11	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R12	PD14CY2B222J	Carbon 2.2kΩ ±5% 1/8W	
R13	PD14CY2B561J	Carbon 560Ω ±5% 1/8W	
R14	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R15	PD14CY2B333J	Carbon 33kΩ ±5% 1/8W	
R16	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R17, 18	PD14CY2B332J	Carbon 3.3kΩ ±5% 1/8W	
R19	PD14CY2B682J	Carbon 6.8kΩ ±5% 1/8W	
R20	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R21	PD14CY2B153J	Carbon 15kΩ ±5% 1/8W	
R22	PD14CY2B222J	Carbon 2.2kΩ ±5% 1/8W	
R23	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R24	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R25	PD14CY2B393J	Carbon 39kΩ ±5% 1/8W	
R26	PD14CY2B561J	Carbon 560Ω ±5% 1/8W	

Ref. No.	Parts No.	Description	Re- marks
R27	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R28	PD14CY2B333J	Carbon 33kΩ ±5% 1/8W	
R29	PD14CY2B823J	Carbon 82kΩ ±5% 1/8W	
R30	PD14CY2B151J	Carbon 150Ω ±5% 1/8W	
R31	PD14CY2B223J	Carbon 22kΩ ±5% 1/8W	
R32, 33	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R34	PD14CY2B333J	Carbon 33kΩ ±5% 1/8W	
R35	PD14CY2B154J	Carbon 150kΩ ±5% 1/8W	
R36	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R37	PD14CY2B224J	Carbon 220kΩ ±5% 1/8W	
R38	PD14CY2B222J	Carbon 2.2kΩ ±5% 1/8W	
R39	PD14CY2B333J	Carbon 33kΩ ±5% 1/8W	
R40	PD14CY2B562J	Carbon 5.6kΩ ±5% 1/8W	
R41, 42	PD14CY2B561J	Carbon 560Ω ±5% 1/8W	
R43	PD14CY2B154J	Carbon 150kΩ ±5% 1/8W	
R44	PD14CY2B681J	Carbon 680Ω ±5% 1/8W	
R45	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R46	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R47	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R48	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R49	PD14CY2B223J	Carbon 22kΩ ±5% 1/8W	
R50	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R51~54	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R55, 56	PD14CY2B682J	Carbon 6.8kΩ ±5% 1/8W	
R57	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R58	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R59, 60	PD14CY2B563J	Carbon 56kΩ ±5% 1/8W	
R61, 62	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R63	PD14CY2B153J	Carbon 15kΩ ±5% 1/8W	
R64	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R65	PD14CY2B683J	Carbon 68kΩ ±5% 1/8W	
R66	PD14CY2B223J	Carbon 22kΩ ±5% 1/8W	
R67	PD14CY2B562J	Carbon 5.6kΩ ±5% 1/8W	
R68	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R69	PD14CY2B331J	Carbon 330Ω ±5% 1/8W	
R70	PD14CY2B222J	Carbon 2.2kΩ ±5% 1/8W	

SEMICONDUCTOR

Q1, 2	V03-0375-05	Transistor 2SC1070	
Q3	V03-0079-05	Transistor 2SC460 (B)	
Q4	V03-0053-05	Transistor 2SC388A	
Q5	V03-0287-05	Transistor 2SC387A	
Q6	V30-0006-00	IC TA7045M (red)	
Q7, 8	V03-0079-05	Transistor 2SC460 (B)	
Q9	V30-0138-05	IC TA7120P	
Q10~14	V03-0079-05	Transistor 2SC460 (B)	
Q15, 16	V03-0129-05	Transistor 2SC733 (Y), (O)	
D1~5	V11-0051-06	Diode 1N60	
D6	V11-0076-05	Diode 1S1555	
D7	V11-0051-05	Diode 1N60	
D8	V11-0076-05	Diode 1S1555	

POTENTIOMETER

VR1	R12-3036-05	10kΩ (B)	
VR2	R12-4020-05	50kΩ (B)	

COIL

L1~4	L34-0497-05	Air core coil	
L6	L33-0002-05	Choke coil 1μH	
L7	L30-0005-05	IFT (10.7 MHz)	
L8	L71-0021-05	Crystal filter	
L9	L31-0176-05	Tuning coil	
L10, 11	L31-0347-05	Tuning coil	
L12	L33-0002-05	Choke coil	
L13, 14	L34-0498-05	Air core coil	
L15	L40-1021-03	Ferri-inductor	
L16	L30-0005-05	IFT (10.7 MHz)	
L17	L72-0025-05	Ceramic filter	
L18	L30-0199-05	IFT (455 kHz)	

PARTS LIST

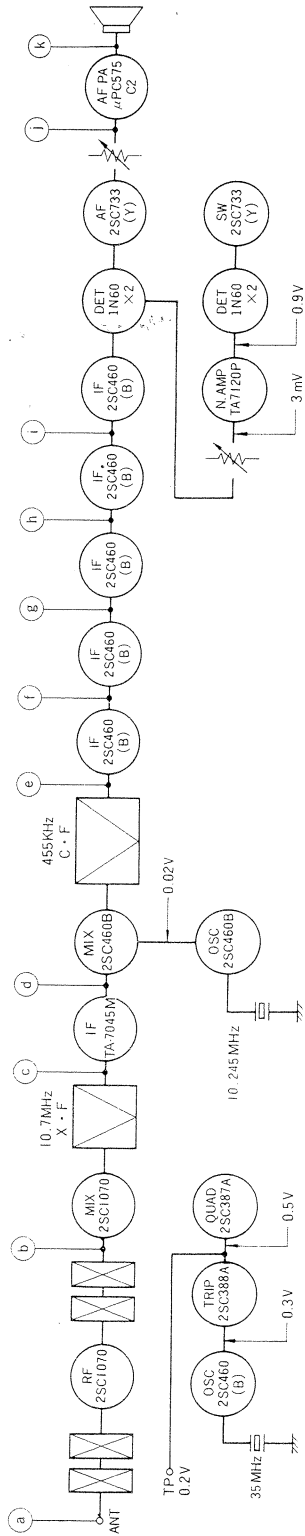
Ref. No.	Parts No.	Description	Re- marks	Ref. No.	Parts No.	Description	Re- marks
R36	PD14CY2B221J	Carbon 220Ω ±5% 1/8W		TC3,4	C05-0031-15	Ceramic trimmer	
R37	PD14CY2E3R3J	Carbon 3.3Ω ±5% 1/4W		TC5	C05-0010-15	Ceramic trimmer	
R38	PD14BY2E101J	Carbon 100Ω ±5% 1/4W		TC6,7	C05-0013-15	Ceramic trimmer	
R39	PD14CY2E270J	Carbon 27Ω ±5% 1/4W		MISCELLANEOUS			
R40	RC05GF2H151J	Carbon 150Ω ±5% 1/2W		—	E23-0047-04	Terminal x 23	
R41	PD14CY2B471J	Carbon 470Ω ±5% 1/8W		—	F01-0218-04	Heat sink	
R42	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W		—	F02-0030-05	Radiator x 2	
R43	RC05GF2H100J	Carbon 10Ω ±5% 1/2W		—	F10-0376-04	Shield plate	
R44	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W		—	F20-0078-05	Insulating plate x 2	
R45	PD14CY2B562J	Carbon 5.6kΩ ±5% 1/8W					
R46	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W					
R47	PD14CY2B222J	Carbon 2.2kΩ ±5% 1/8W					
R48	PD14CY2B332J	Carbon 3.3kΩ ±5% 1/8W					
R49	RC05GF2H680J	Carbon 68Ω ±5% 1/2W					
R50	PD14CY2B124J	Carbon 120kΩ ±5% 1/8W					
R51	PD14CY2B154J	Carbon 150kΩ ±5% 1/8W					
R52	PD14CY2B473J	Carbon 47kΩ ±5% 1/8W					
R53	PD14CY2B822J	Carbon 8.2kΩ ±5% 1/8W					
R54	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W					
R55	PD14CY2B561J	Carbon 560Ω ±5% 1/8W					
SEMICONDUCTOR							
Q1	V30-0039-05	IC TA7061AP					
Q2~4	V03-0079-05	Transistor 2SC460 (B)					
Q5~7	V03-0053-05	Transistor 2SC388A					
Q8	V03-0168-05	Transistor 2SC998					
Q9, 10	V03-0275-05	Transistor 2SC1165					
Q11	V03-0411-05	Transistor 2SC1724					
Q12	V01-0032-05	Transistor 2SA562 (Y)					
Q13	V03-0336-05	Transistor 2SC496 (Y), (O)					
Q14, 15	V04-0046-05	Transistor 2SD235 (Y), (O)					
Q16	V03-0241-05	Transistor 2SC735 (Y)					
Q17	V30-0107-05	IC μPC575C (2)					
D1	V11-0192-05	Diode 1S1658-1					
D2, 3	V11-0240-05	Diode WZ-090					
D4, 5	V11-0076-05	Diode 1S1555					
D6	V11-0051-05	Diode 1N60					
D7, 8	V11-0076-05	Diode 1S1555					
POTENTIOMETER							
VR1, 2	R12-2015-05	5kΩ (B)					
VR3	R12-1015-05	3kΩ (B)					
VR4	R12-4016-05	50kΩ (B)					
VR5	R12-5014-05	100kΩ (B)					
COIL							
L1	L40-1021-03	Ferri-inductor					
L2	L40-1545-06	Ferri-inductor					
L3	L31-0176-05	Tuning coil 24 MHz					
L4	L34-0505-05	Tuning coil 24 MHz					
L5	L34-0506-05	Tuning coil 24 MHz					
L6	L34-0505-05	Tuning coil 24 MHz					
L7~9	L34-0507-05	Tuning coil 72 MHz					
L10~13	L31-0347-05	Tuning coil 144 MHz					
L14	L34-0499-05	Air core coil (4T)					
L15	L34-0452-05	Air core coil (A) (6T)					
L16	L34-0453-05	Air core coil (B) (3T)					
L17	L34-0432-05	Air core coil (1T)					
L19	L33-0261-05	Choke coil (12T)					
L20	L34-0500-05	Air core coil					
L21	L34-0454-05	Air core coil (1/2T)					
L22	L34-0452-05	Air core coil (A) (6T)					
L25	L33-0260-05	Choke coil (8T)					
L26	L40-1021-03	Ferri-inductor					
L27	L34-0452-05	Air core coil (6T)					
TRIMMER							
TC1	C05-0062-05	Ceramic trimmer					
TC2	C05-0030-15	Ceramic trimmer					

TROUBLESHOOTING

SYMPTOM	SERVICE POINT	CAUSE	REMEDY
1. Power is not supplied.	1. Fuse 2. Power cord 3. Power switch	Fuse blown Plug connection faulty Poor contacts	Check fuse Repair plug connection Repair power switch
2. No signal reception Noise can be heard. Noise can not be heard although S meter gives some indication. At specified channel, noise can be heard.	1. Power supply 1. RF circuit 1. AF circuit 2. Speaker 3. AF, VR 1. Crystal	Defective RX AVR Defective Q1 Defective Tr, IC Speaker, connecting cable Broken wire Dislocation Defective crystal	Check R9 voltage Check and replace Check voltage at each stage Check and replace Check and replace Check and correct Check and replace
3. Low sensitivity	1. RF circuit 2. IF circuit 3. OSC circuit	Defective Tr Poor adjustment of tuning circuit Poor adjustment of coil Ceramic filter defective Insufficient output voltage	Check and replace Readjust Readjust Check and replace Check and readjust
4. S meter gives no indication.	1. S meter 2. Measuring sensitivity	Deteriorated Poor sensitivity	Check and replace Refer to 2, 3 in SYMPTOM
5. Sound is distorted.	1. AF circuit 2. Crystal OSC circuit	Malfunction Frequency shift	Check and replace Check and readjust
6. No output power	1. Stabilized power supply 2. TX unit 3. Crystal 4. Filter unit	Malfunction Defective Q11 Defective the other Tr Deterioration Defective D1, D2	Check T9 voltage Check voltage Check voltage Check and replace Check and replace
7. Low output power	1. Final Tr 2. Driver circuit	Poor adjustment of each trimmer Poor adjustment of each trimmer	Readjust Readjust
8. Output power is disorder in LOW position.	1. Supply voltage setting circuit 2. Supply voltage selecting switch	Off adjustment of VR3 Poor contact	Readjust Check and repair
9. No modulation is performed.	1. Modulation circuit	Defective microphone Poor contact of mic gain setting VR Deteriorated Q1	Check and replace Check and repair Check and replace
10. Distorted modulation sound	1. Modulation circuit 2. OSC circuit	Misadjustment of L3, 4, 5	Refer to 9 in SYMPTOM Readjust
11. RF meter shows no indication.	1. Final circuit	Defective D6 Poor contact of VR4	Check and replace Check and repair

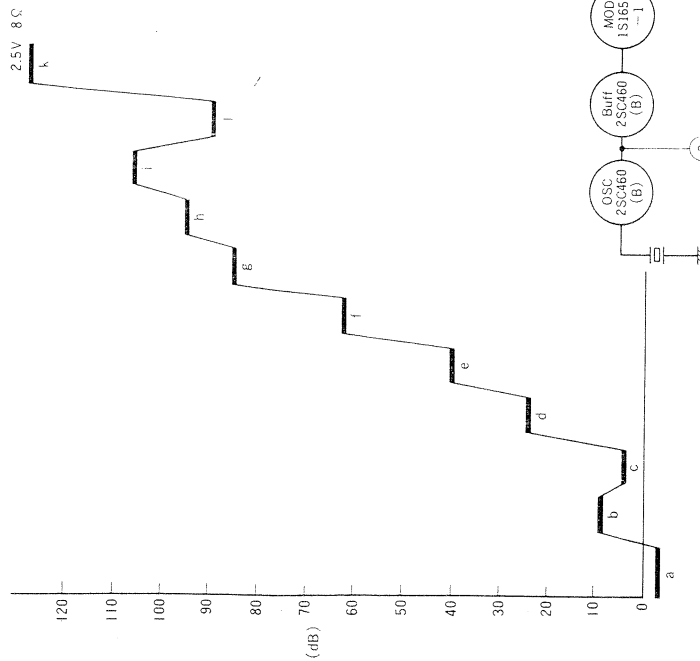
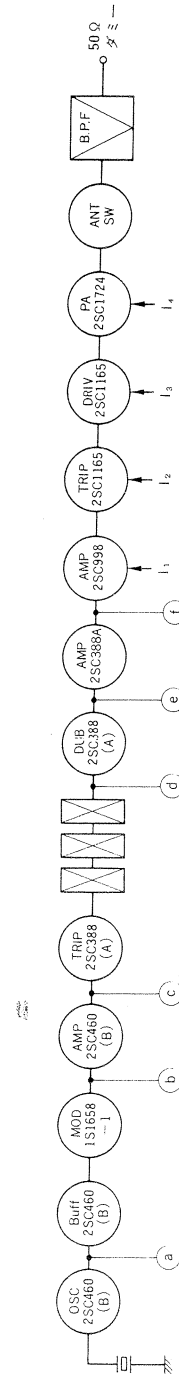
LEVEL DIAGRAM

RX



TX

level (Vrms)	a	b	c	d	e	f	I_1 /power	I_2 /po	I_3 /po	I_4 /po
	0.17	0.09	0.9	2.1	0.8	1.3	40mA	80mA/0.2W	90mA/0.28W	400mA/2.5W



ADJUSTMENT

ALIGNMENT AND SERVICE TEST EQUIPMENT

1. Frequency Counter

Frequency range: 500 MHz or more
(up to about 150 MHz available)

2. Standard Signal Generator (SSG)

Frequency generated: 432 MHz band, capable of frequency modulation

Output voltage: -10 dB ~ 100 dB

Frequency deviation: 7.5 kHz

Modulation frequency: 1 kHz

3. Oscilloscope

High sensitivity oscilloscope capable of external synchronization

4. AF VTVM

Frequency range: 50 Hz ~ 10 kHz

Input impedance: 1 M Ω or more

Voltage range: 10 mV ~ 30 V Full scale

5. RF VTVM

Frequency range: 500 MHz or more

Input impedance: 1 M Ω or more

20 pF or less

Voltage range: 10 mV ~ 300 V Full scale

6. Tester

Internal resistance: DC 33.5 k Ω /V or more

7. Power Meter

Impedance: 50 Ω

Meter calibration: 0.5 Watts, 5 Watts, 20 Watts or so

Frequency range: 500 MHz or more

SWR: Less than 1.2

8. AG

Output frequency range: 300 Hz ~ 10 kHz

Output voltage: 1 V or more

9. Center Meter

Current sensitivity: 50 ~ 100 μ A or so

10. DC Regulated Power Supply

Voltage range: 9 ~ 16 V

Current range: 1 A or more, with a ampere meter

11. Linear Detector

Frequency range: 432 MHz or so

12. Sweep Generator

435 MHz band

GENERAL

In order to perform alignment, it is necessary that TR-3200 can be handled and treated skillfully.

If not yet, read the operating manual again.

And the following paragraphs should be regarded.

1. POLARITY OF THE POWER CORD

Be sure that the yellow is for (+), the black for (-).

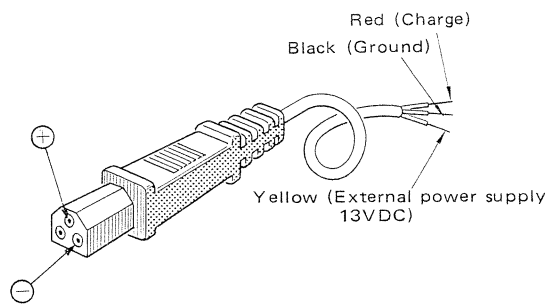


Fig. 2

2. DISASSEMBLY

Pull slightly two plunger located on the rear and pull the front panel out of the case as shown in Fig. 3.

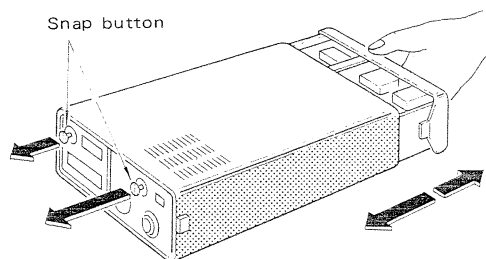


Fig. 3

3. REPLACEMENT OF THE PARTS ON THE PC BOARD

The parts on the PC board both RX and TX can be replaced after dismantling RX PC board.

The procedure of dismantling is as follows:

ADJUSTMENT

- (1) Remove the plastic cover over the crystals with two retainers.
- (2) Remove the shield cover of filter unit upward.
- (3) Remove the spring shock absorber upward.
- (4) Unsolder the input lead from the antenna terminal.
- (5) Unscrew RX PC board.
- (6) Lift TX PC board at the rear in the direction as shown in Fig. 4.

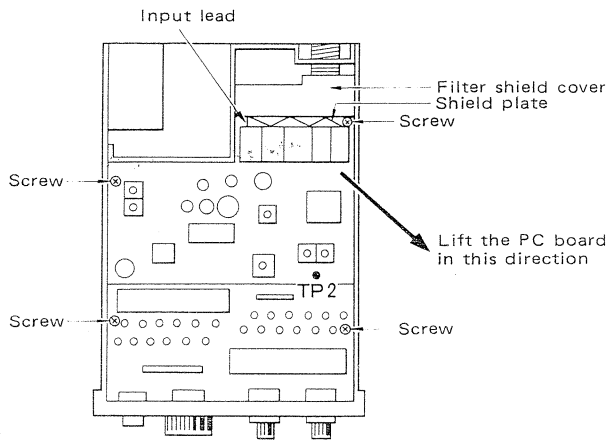


Fig. 4

4. 5/8 ROD ANTENNA (WHIP ANTENNA) APPENDED

This rod antenna contains two compartments as shown in Fig. 5, being assembled by twisting into a screw.

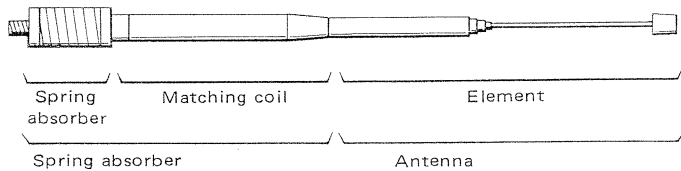


Fig. 5

RECEIVER ALIGNMENT

NOTES:

This adjustment should be performed under following condition unless the specified condition is stated.

1. Receiving frequency: 435.00 MHz
2. Squelch: Minimum
3. Power supply: DC 13.0 V (at the power jack of TR-3200)
4. Load impedance of the EXT. SP. terminal: 8 Ω
5. SSG setting
 - Mode: FM
 - Frequency deviation: 5 kHz
 - Modulation frequency: 1 kHz
 SSG should be used through a 50 Ω unbalanced pad. (Depending on the SSG design used, no pad may be required.)

I Frequency Adjustment

1. First remove the case, and cable to the power supply. Connect the RF VTVM to TP2 on the RX unit (X55-1100-61) as shown in Fig. 6.

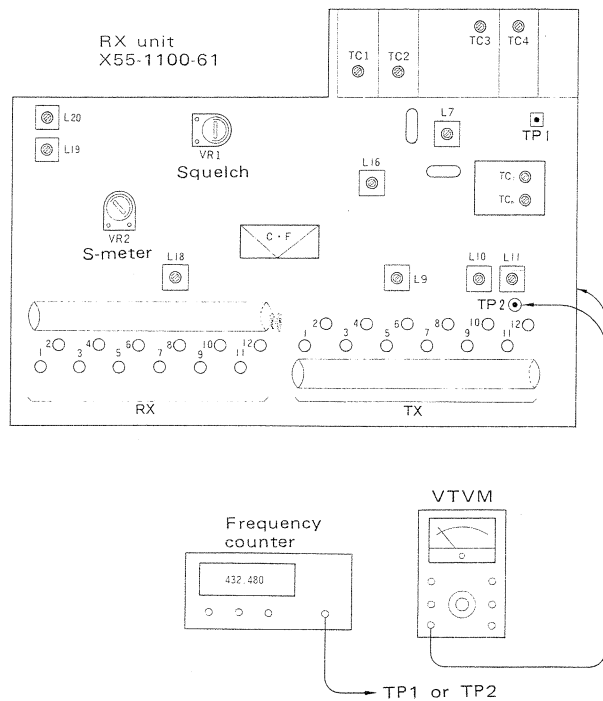


Fig. 6 RX Unit

2. Set the channel knob to R72 and install a 435 MHz crystal into the position. Set the core of OSC coil L9 to the bottom of the case by turning it clockwise. Then turning the core counterclockwise, pull it out gradually and seek the position at which the crystal oscillates. Furthermore turn the core counterclockwise by 1/2 rotation from the oscillating position.

ADJUSTMENT

- Set TC6, 7 for maximum capacitance and peak the RF VTVM indication, adjusting L10, 11.
- Connect the frequency counter to TP2 and adjust frequency at each channel as follows:

Channel knob	Frequency	Counter reading	ADjusting trimmer
R70	438.650 MHz	106.9875 MHz	TC8
R80	438.900 MHz	107.0500 MHz	TC13
A	432.000 MHz	105.3250 MHz	TC17

NOTE: Regarding the frequency adjustment other than the above, refer to Table 2.

Frequency (MHz)	Output frequency (MHz)		Remarks
	TP2 output	TP1 output	
431.04	105.08500	420.34000	
16	105.11500	420.46000	
28	105.14500	420.58000	
40	105.17500	420.70000	
52	105.20500	420.82000	
64	105.23500	420.94000	
76	105.26500	421.06000	
88	105.29500	421.18000	
432.00	105.32500	421.30000	
12	105.35500	421.42000	
24	105.38500	421.54000	
36	105.41500	421.66000	
48	105.44500	421.70000	
60	105.47500	421.90000	
72	105.50500	422.02000	
84	105.53500	422.14000	
96	105.56500	422.26000	
Calculation	$\frac{\text{Receiving frequency} - 10.7}{4}$	Receiving frequency - 10.7	

Table 2 Frequency Adjustment

II RF Circuit Adjustment

- Connect the sweep generator, the oscilloscope, the SSG, and the power supply as shown in Fig. 7.

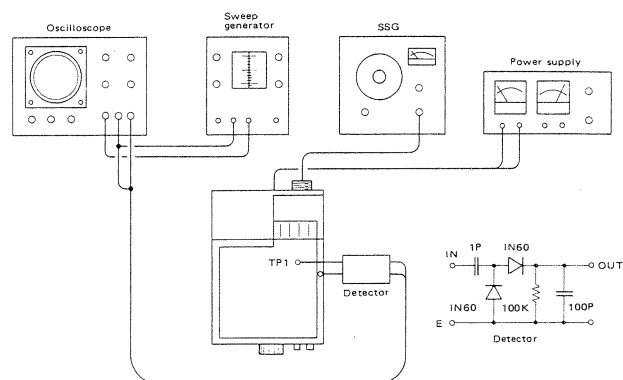
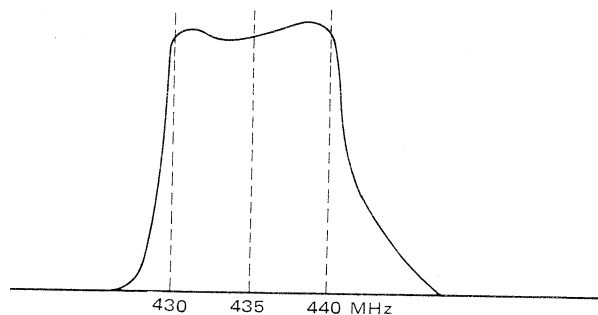


Fig. 7 RF Circuit Adjustment

- Supply the DC power of 13.0 V. Set VERT. GAIN of the oscilloscope to full on and TR-3200 to receiving mode.
- Set TC1 ~ 4 of the RF stage to the half position in capacitance and the frequency of the sweep generator to about 435 MHz. Increasing the output of the sweep generator, display some waveform on the oscilloscope.
- Using the SSG output set to about 435 MHz as marker, adjust the passband ranging from 430 ~ 440 MHz by TC1 ~ 4 so as to indicate the waveform as shown in Fig. 8.



NOTE: The skirt selectivity in lower edge (430 MHz side) must descend sharply, while in upper edge (440 MHz side) it may allow slope to some extent.

Fig. 8 Skirt Characteristic

ADJUSTMENT

CARRIER FREQ : 432.00MHz

III Sensitivity Adjustment

1. Connect the SSG, AF VTVM and the oscilloscope to TR-3200 as shown in Fig. 9.

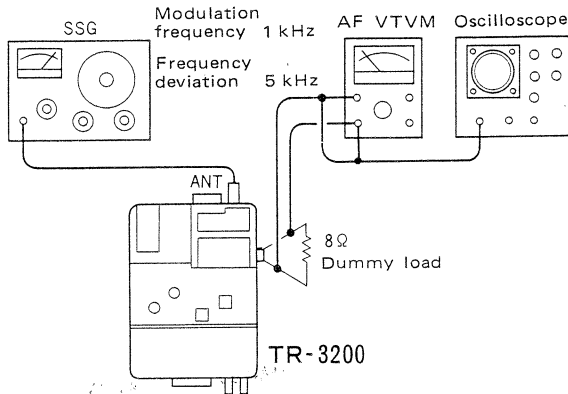


Fig. 9 Sensitivity Adjustment

2. Apply a signal from SSG and display the AF waveform on the oscilloscope.
3. Decreasing the SSG output gradually, adjust TC6, 7 and L10, 11, 7, 16 to obtain maximum sensitivity.
4. Again increase SSG output until the S meter of TR-3200 shows indication of 4 ~ 5 and adjust L10, 11, TC6, 7, L7 and L16 for maximum S meter reading.
5. Measuring sensitivity of the receive section, confirm to satisfy the following value.

Bandwidth	Signal strength	S/N
432.0 ~ 438.5 MHz	1 μ V	More than 20 dB
431.0 ~ 431.9 MHz	1.4 μ V	More than 20 dB
438.6 ~ 439.5 MHz	1.4 μ V	More than 20 dB

IV S Meter Adjustment

1. Apply the SSG signal of 30 dB at 435.00 MHz for maximum TR-3200 S meter reading.
2. Adjust VR2 so that S meter shows indication of 10.

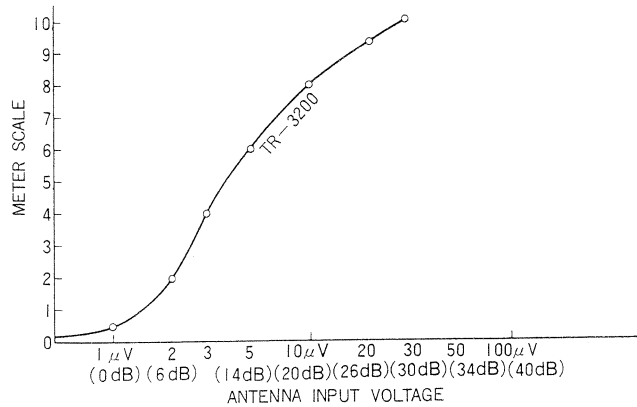


Fig. 10 An Example of S-Meter Sensitivity

V Center Meter Zero Adjustment

1. Connect the center meter to the 9P connector located on the rear panel. (9 pin + , 4 pin -)
2. Apply the SSG signal of 10 dB and adjust L19 to obtain maximum AF output.
3. Then set the channel knob to a vacant position and adjust L20 for "0" reading of the center meter.

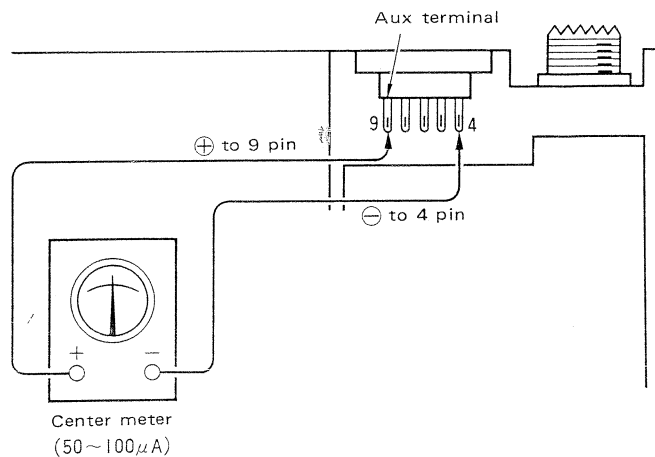


Fig. 11 Center Meter Zero

VI SQUELCH Adjustment

1. Set the channel knob to 435.00 MHz position.
2. At no signal adjust VR1 so the squelch circuit starts its work when the squelch volume is turned to twelve o'clock position.

ADJUSTMENT

TRANSMITTER ALIGNMENT

NOTES:

1. Use a power meter with impedance of 50Ω , SWR of 1.2 or less.
2. Use a microphone with impedance of 500Ω .
3. Supply voltage is stated provided that the built-in terminal is used.

I Multiplier Stage Adjustment

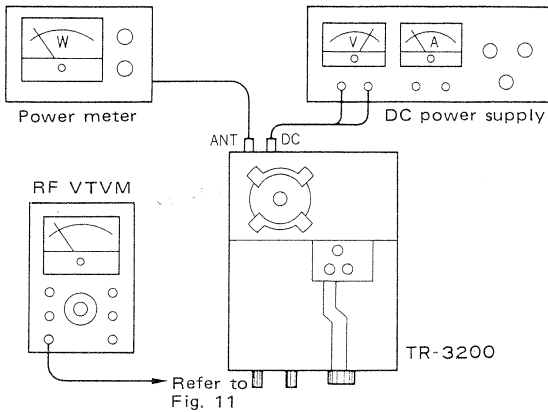


Fig. 12 Cabling of Test Equipment

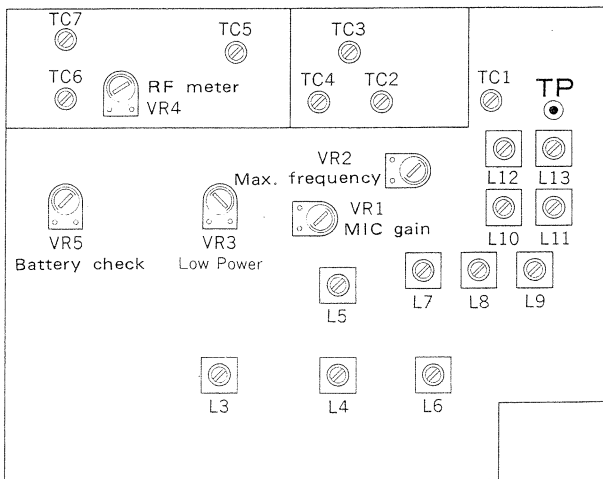


Fig. 13 TX Unit (X56-1180-00)

1. Set the channel knob to A position (432.00 MHz) and supply DC 9 V.
2. Turn the ST-BY switch on and connect the RF VTVM (0.3 V range) to the base of Q3. First turn the core of L3 fully downward to the bottom.

Then turning the core counterclockwise, pull it out gradually and seek the position at which the crystal oscillates.

Furthermore turn the core counterclockwise by 1-1/4 rotation from the oscillating position.

NOTE: Excessive rotation more than 1-1/4 may cease oscillation and insufficient rotation less than 1-1/4 may occur distorted modulation.

3. Connect the RF VTVM (1 Volt range) to the base of Q6 and adjust L4, L6 to obtain maximum output.
4. Connect RF VTVM to TP terminal and adjust L7 ~ 13 for maximum output.
5. Repeat above 3 and 4 steps about twice.

II Power Adjustment

Connect the power meter and DC power supply with set to 9 V as shown in Fig. 12.

NOTE: Correctly set DC power supply output to 9 V because this adjustment is greatly affected by source voltage fluctuation.

1. High Power Adjustment

- (1) Set the knob on the front panel to HIGH position. Adjust TC1, L12 and L13 to obtain maximum indication on the am-meter.
- (2) Increase supply voltage to 13 V and adjust TC3 ~ 7 for maximum indication on the power meter.
- (3) Reset supply voltage to 9 V, and adjust TC1 ~ 4 for maximum indication on the power meter.
- (4) Again increase supply voltage to 13 V and turn TC7 in the direction decreasing capacitance to give the reading of 2.2 W on the power meter. In this time, consuming current reaches 650 ~ 700 mA. (The channel indication lamp should be off.) (Fig. 14)

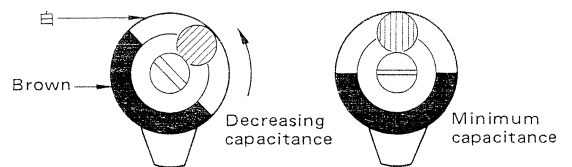


Fig. 14 Adjustment of TC7

2. Low Power Adjustment

- (1) After performing HIGH power adjustment, set the knob to LOW position.
- (2) Adjust VR3 so that power meter gives the reading of 0.4 W.

ADJUSTMENT

III RF Meter Adjustment

1. Connecting the power meter to the antenna, supply DC 13V to TR-3200. Set TR-3200 to transmitting mode at HIGH position.
2. Adjust VR4 for RF meter indication of 8.

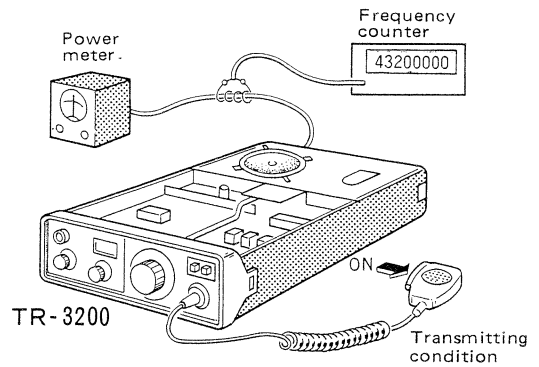


Fig. 16 Frequency Adjustment

IV Adjustment of Modulation

- (1) Connect test equipments as Fig. 15 (Refer to Fig. 13 concerning adjusting points.)

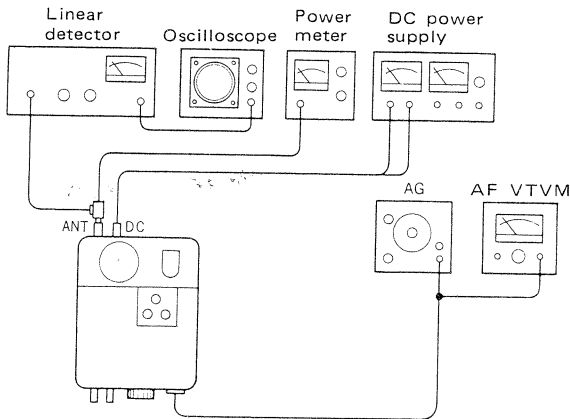


Fig. 15 Adjustment of Modulation

- (2) Apply a signal of 3 mV at 1 kHz from AG to MIC terminal.
Adjust L5 so that the linear detector shows a maximum and symmetrical wave form.
- (3) Adjustment of maximum frequency deviation
Increase the applied signal to 30 mV, and adjust VR2 to obtain 7.5 kHz linear detector indication.
- (4) Adjustment of mic gain
Decreasing the applied signal to 3 mV again, adjust VR1 for 5 kHz linear detector indication.
- (5) Turn TONE SW on in transmitting mode, adjust VR1 on the TONE unit for 3 kHz linear detector indication.
Frequency deviation should not fluctuate at each frequency.

V Frequency Adjustment

1. Connect a frequency counter to the power meter cable by winding as Fig. 11. Adjust TC20, 25, 29 for the following counter reading at each channel.

R70	431.050 MHz	TC20
R80	431.300 MHz	TC25
A	432.00 MHz	TC29

2. When installing a new crystal, adjust in the same way as above.

VI Battery Check

1. With supply voltage of 9.6V, set the squelch knob to BATT position.
2. Adjust VR5 in TX unit (Fig. 13) to show the meter reading as Fig. 17.

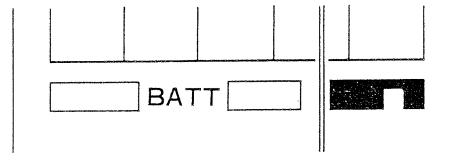
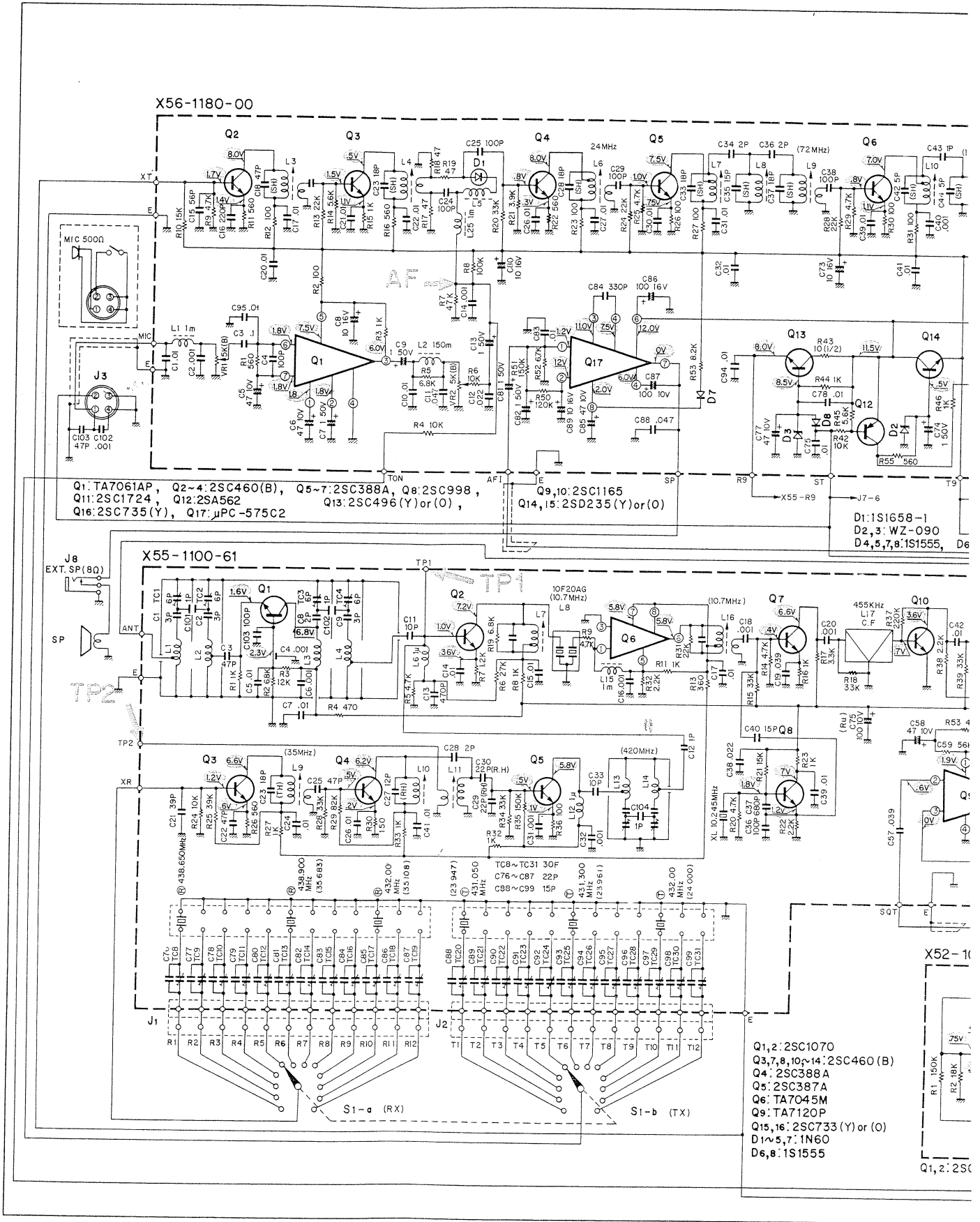


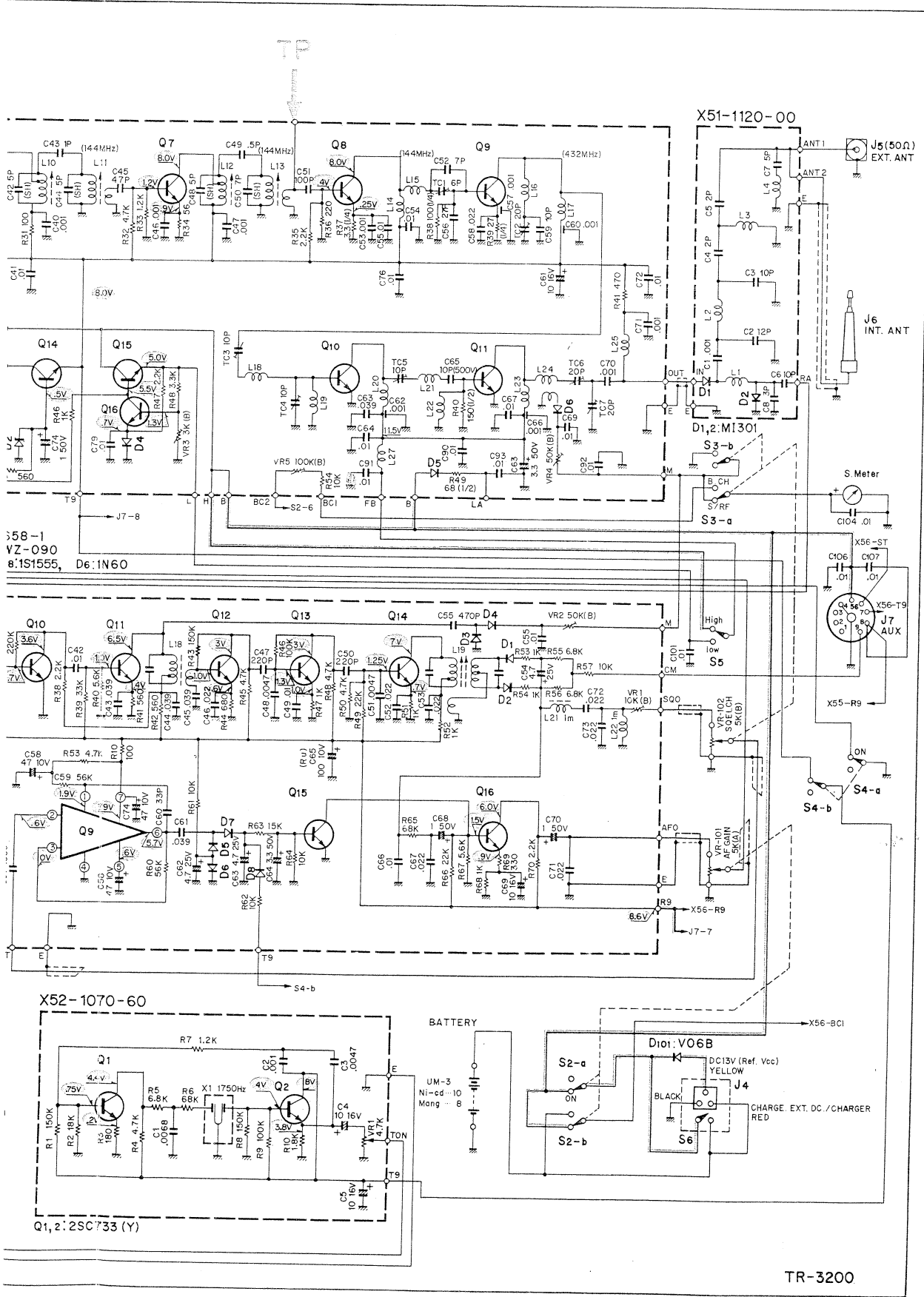
Fig. 17 Battery Check

[CHECK POINT]

1. Operating with a fixed channel output of 2W or more, 2.5W or less should be obtained at each band edge (431.00 MHz and 434.00 MHz).
2. With the supply voltage shifting of 9.6 V to 15.6 V, undesirable matters such as parasitic oscillation should not be occurred.
3. Stable operation should be confirmed with the appended whip antenna.
4. With switching the HIGH-LOW selecting switch, tone quality and modulation tone should not vary.



MATIC DIAGRAM



- 2SC1070
- 2SC460B
- 2SA562 (Y)
- 2SC387A
- 2SC388A
- 2SC733 (Y) (O)
- 2SC735 (Y)
- TA-7045M
- TA-7061P
- TA-7120P
- 2SC998
- 2SC1165
- 2SC1724
- 2SC496
- 2SD235
- μPC575C2
- NEC 575C2

TR-3200