

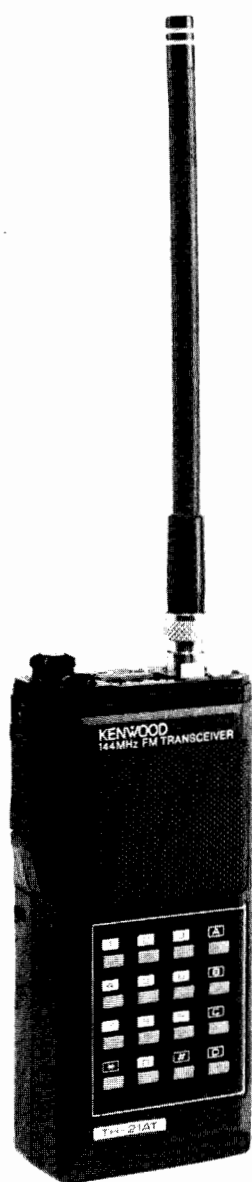
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# KENWOOD

# SERVICE MANUAL

## TH-21A/AT/E BT-2, DC-21, EB-2, PB-21, SC-8/8T, SMC-30, TU-6

### 2m FM HAND-HELD TRANSCEIVER



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Photograph shows TH-21AT type.

## CIRCUIT DESCRIPTION

Model	Destination	Frequency range (MHz)	RPT-SHIFT Freq' (kHz)	TONE	Ref'
TH-21A	K1,M1,M2	144.00–147.995	±600	Option (TU-6)	DTMF System used
	X	144.00–145.995			
TH-21AT	K2,M3,M4	144.00–147.995			
TH-21E	T	144.00–145.995	–600/REV	1750Hz TONE BURST	TRIO Brand
	W			1750 Hz TONE	

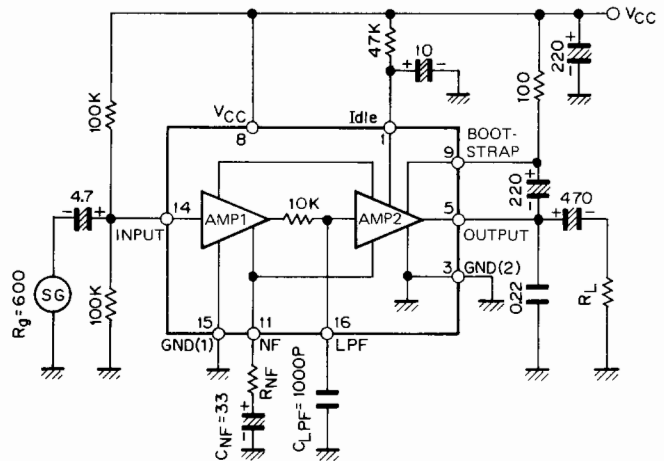
K : U.S.A. M : Gen. T : England W : Europe X : Australia/Newzealand

**Table 1 Destination chart**

### RX Section

The TH-21A/AT/E uses a double super-heterodyne type receiver with a IF frequency of 16.3MHz and a second IF frequency of 455kHz.

The received signal from the antenna is amplified by RF amplifiers Q1 : 2SC2176(H) and Q2 : 2SC2668(Y), which are in connected cascade, and applied to BPF L6–L8. The RF signal is then applied to the first mixer, Q3 : 2SK192A, where it is mixed with the first local oscillator signal from the PLL. The first mixer output passes through a 16.3MHz MCF (F1) and becomes the first IF signal. This signal is amplified by IF amplifier Q4 : 2SC2714(Y) and is applied to IF unit Q1 : MC3359P



**Fig. 1 TA7331F Block diagram (IF unit Q2)**

Item	Rating
Noninal center frequency (fo)	16.3MHz
Pass bandwidth	fo ± 7.5kHz or more at 3dB
Attenuation bandwidth	fo ± 25kHz or more at 18dB
Guaranteed attenuation	30dB or more within fo ± 1MHz Spurious : 15dB or more at fo ~ fo + 500kHz.
Ripple	0.5dB or less
Insertion loss	1.0dB or less
Terminal impedance	1kΩ/1.5pF

**Table 2 MCF (L71-0426-05) (RF unit F1)**

Item	Rating
Center frequency of 6dB bandwidth (fo)	455kHz ± 1.5kHz
6dB bandwidth	± 7.5kHz or more
40dB bandwidth	± 15kHz or less
Ripple	1.5dB or less (455 ± 5kHz)
Guaranteed attenuation	27dB or more within fo ± 100kHz
Insertion loss	6dB or less at 455kHz
Terminal impedance	1.5kΩ

**Table 3 Ceramic filter (L72-0335-05) (IF unit F1)**

Q1 consists of the second mixer, second local oscillator, second IF amp, FM demodulator, squelch noise amp and control circuits.

The demodulated audio signal from Q1 is amplified by AF amplifier Q2 : TA7331F, on the IF unit, via the AF volume control (VR1 on the switch unit) to drive the speaker.

The squelch circuit, (an auxiliary circuit of the receiver section) detects the high frequency noise component of the demodulated audio output from Q1.

This signal is applied to pin 12 of Q1 via the squelch control, (VR2 on the switch unit). The noise component applied to pin 12, is amplified and then output at pin 13. The output at pin 13 is rectified by D1 and D2 : 1N60As and fed to pin 14. When this rectified voltage is applied to pin 14, the squelch trigger circuit functions, pin 16 is grounded, and Q4 : 2SC2412K and Q3 : 2SB698(E,F) turn OFF. When Q3 turns OFF, AF amp IC Q2 : TA7331F is muted and no audio is output. When a signal is received, the noise level contained in the demodulated output of Q1 reduced, and the squelch trigger circuit does not function. Therefore, Q4 and Q3 turn ON, the AF amp IC is powered, and audio output is obtained.

## CIRCUIT DESCRIPTION

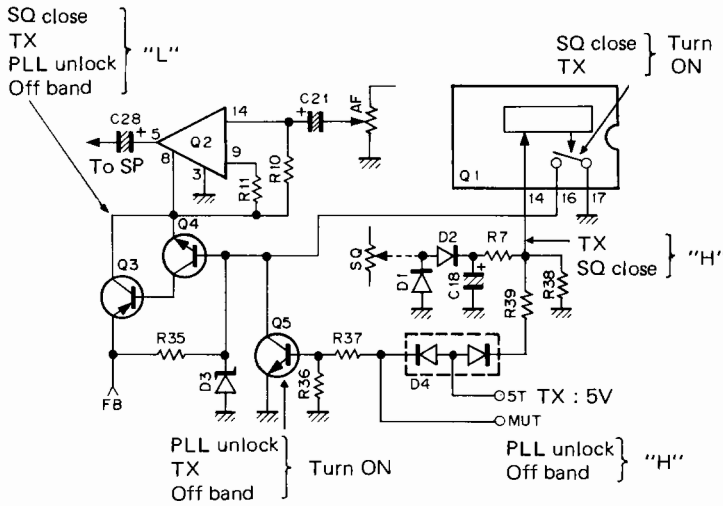


Fig. 2 Squelch-mute circuit

### TX Section

The VCO local oscillator Q14 : 2SC2714(Y) frequency in transmit is one half the actual TX frequency. The output of VCO buffer amp Q16 : 2SC2671(H) is doubled by Q5 : 2SC2668(Y) and fed through a BPF to obtain the TX frequency. The output of the BPF is fed to pre-driver, Q6 : 2SC2347, driver Q7 : 2SC2053, and is then amplified by the final amplifier Q8 : 2SC1947.

	VCBO	VEBO	VCEO	IC	PC	PC	T <sub>j</sub>	T <sub>stg</sub>	T <sub>a</sub>
Test Conditions			RBE = ∞ Ω		T <sub>c</sub> = 25°C	T <sub>a</sub> = 25°C			25 ± 3°C
Maximum Rating	35V	4V	17V	1A	10W	1W	+175°C	-65 ~ +175°C	

Table 4 2SC1947 Max. rating (RF unit Q8)

Signals from the microphone and the tone circuits are amplified by mic amp Q6 : NJM4558M. The signal is then applied to voltage variable capacitor diode D16 : 1S2208 of the VCO circuit to modulate the VCO signal. The transmitter section also consists of the power selector circuit and the tone circuit.

To select the power, the emitter resistor R23 (10Ω) of driver Q7 is controlled by the HI/LO switch (S1) on the IF unit. When R23 is grounded, the output power is about 1W. When R23 is opened, the output power becomes about 150mW.

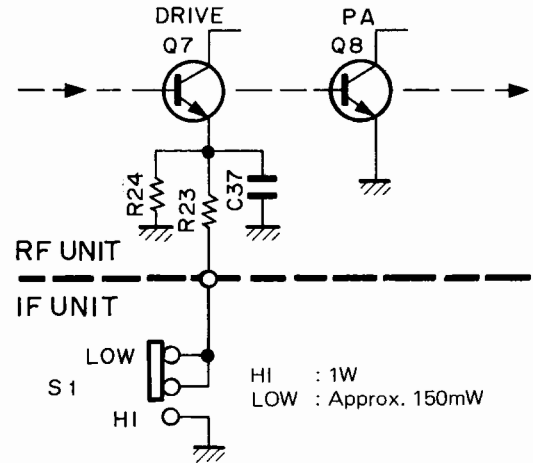


Fig. 3 Power select circuit

Several different tone circuits are available to provide access to repeaters. Circuits vary depending on country of destination.

- 1) In E (W) type models (for European countries), when the TONE switch (a non-locking type) is held depressed, the radio enters TX mode and a tone signal of 1750Hz is emitted.
- 2) In E (T) type models (for the United Kingdom), when the TONE switch is pressed, the radio will enter TX mode and a tone burst of 1750Hz is transmitted.
- 3) The optional tone encoder (TU-6) may be installed in A/AT versions. With the TU-6, any one of 37 frequencies between 67.0–250.3Hz can be transmitted. When the TONE switch is pressed, the tone signal is continuously transmitted.
- 4) In AT type models, a DTMF (Dual-Tone Multi Frequency) system is also used. When a key is pressed, the unit enters TX mode and transmits a dual tone signal as long as the key is held depressed.

## CIRCUIT DESCRIPTION

### PLL Circuit

In RX mode, the VCO oscillates at frequency of 1/2 the first local oscillator [63.85 – 65.8475MHz (T,W,X ; 63.85–64.845MHz)]. In TX mode, the VCO oscillates at a frequency of 1/2 the TX frequency [72–73.9975MHz (T,W,X ; 72 – 72.9975MHz)].

During reception, D15 turns ON to connect C104 into the oscillator circuit which causes the oscillation frequency of the VCO to drop.

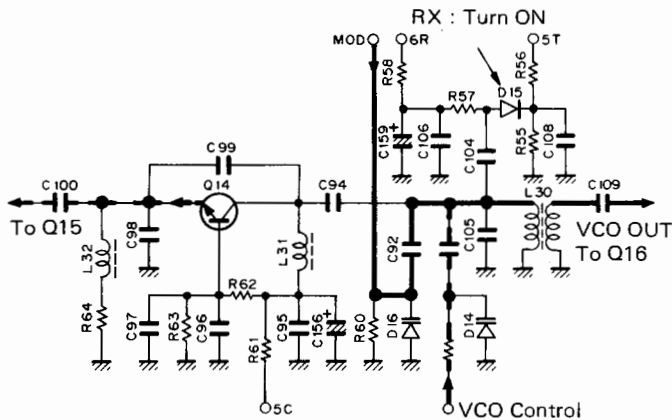


Fig. 4 VCO circuit

The output of the VCO is amplified by Q15 : 2SC2714(Y) and mixed with the HET oscillator Q9 : 2SC2714(Y) signal by PLL mixer Q10 : 2SC2668(Y).

The frequency of the HET oscillator is determined by the crystal selected by the OFFSET switch. Q9 in connection with BPF L25 and L26 acts as a frequency doubler.

The output of PLL mixer Q10 passes through a LPF (L28, C79, C80) to obtain a 2–3.995MHz signal (T,W,X ; 2–2.995MHz). This signal is amplified by Q11 : 2SC2668(Y) and is applied to programmable counter Q3 : TC9122P. The signal input to Q11 is divided by 1/400 at 144.00MHz and 1/799 at 147.99MHz (T,W,X ; 1/599 at 145.99MHz). The actual divide ratio is determined by the thumb-wheel switch, (S2) on switch unit, settings.

The output of Q3 is compared with the (5kHz) reference signal by the phase comparator Q13 : TC5081AP. The 10.24MHz reference oscillator signal is divided by 1/2048 in Q12 : TC5082P to obtain the phase comparator reference frequency. The control voltage output of Q13 is fed through a passive type LPF to voltage variable capacitor diode D14 : ITT310TE of VCO circuit to control the VCO frequency.

Peripheral circuits of the PLL are the +5kHz circuit, and PLL unlock circuits. The +5kHz circuit is used to obtain the 5kHz TX and RX frequencies. In RX mode, when the 5k switch, S3 on switch unit, is set to off, D6 of the PLL HET oscillator circuit is forward biased effectively by passing. When the 5k switch is set to ON, the D6 turns off, which connects TC4 and C61 to crystal (X2) in series.

When a capacitor is connected to the crystal in series, the frequency of oscillation increases. Use TC4 to adjust the +5kHz frequency. The PLL unlock circuit is described in the control circuit section.

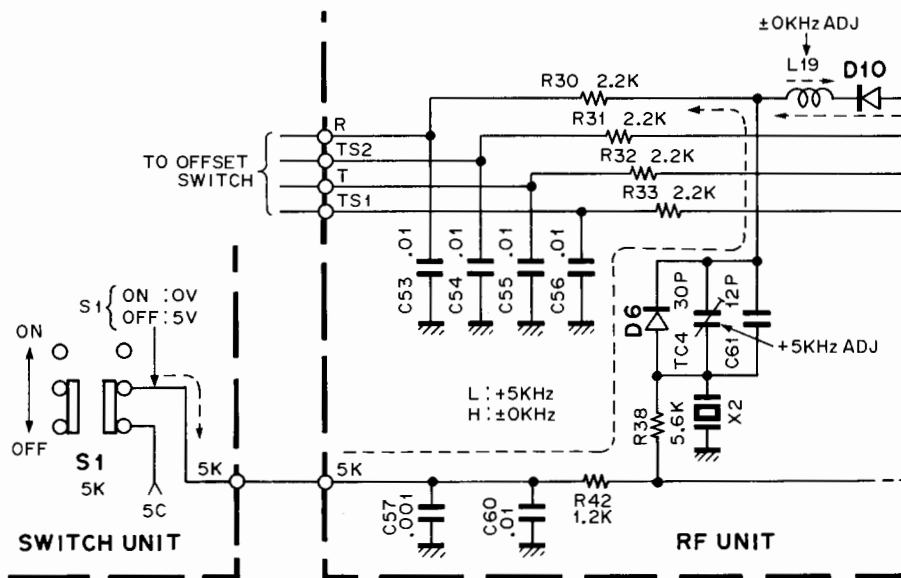
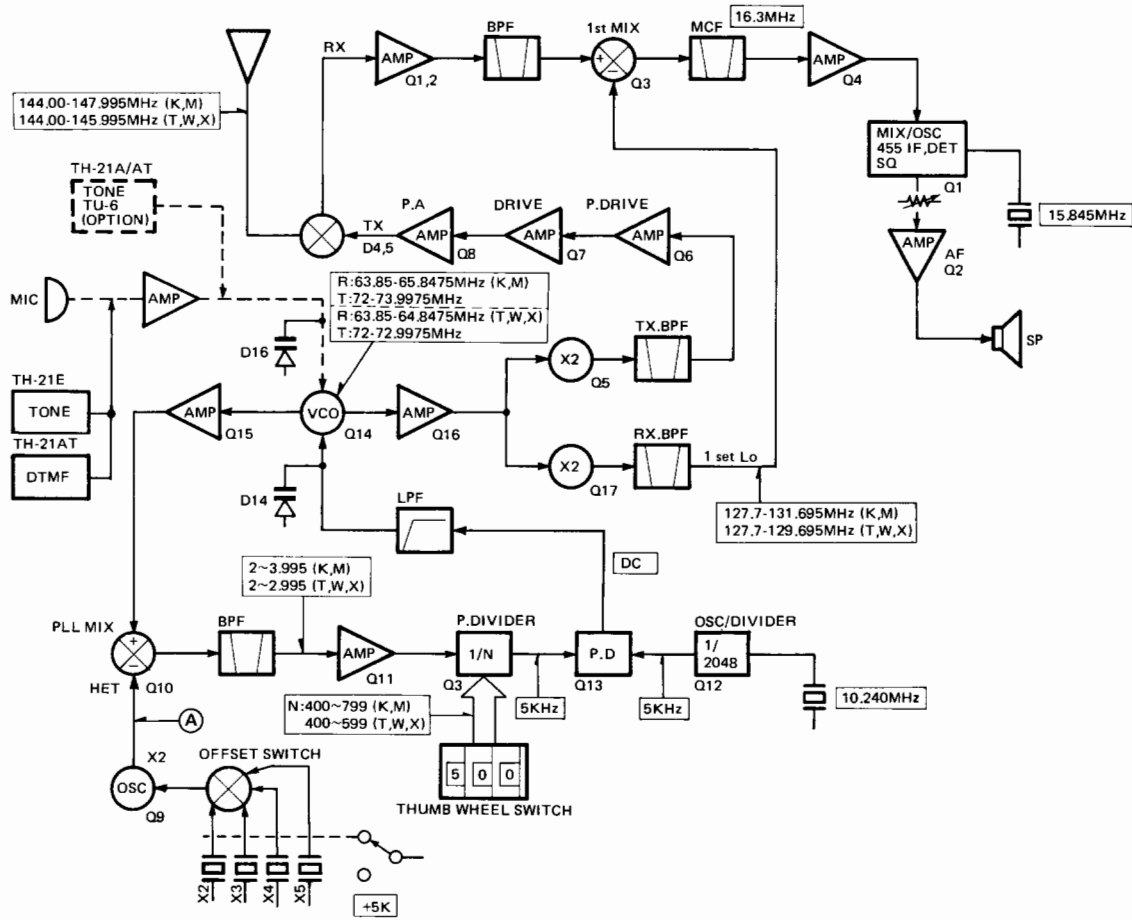


Fig. 5 +5kHz shift circuit

## CIRCUIT DESCRIPTION



**A** TH-21A/AT                      **K,M,X Type**                      TH-21E                      **T,W Type**

	OFF SET Switch			Crystal	
	- (600kHz)	S	+ (600kHz)	X2	X3
RX	X2	X2	X2	X4	X5
TX	X5	X4	X3	X4	X5

	OFF SET Switch			Crystal	
	- (600kHz)	S	REV	X2	X3
RX	X2	X2	X3	X4	X5
TX	X5	X4	X4	X5	X5

Fig. 6 Frequency configuration

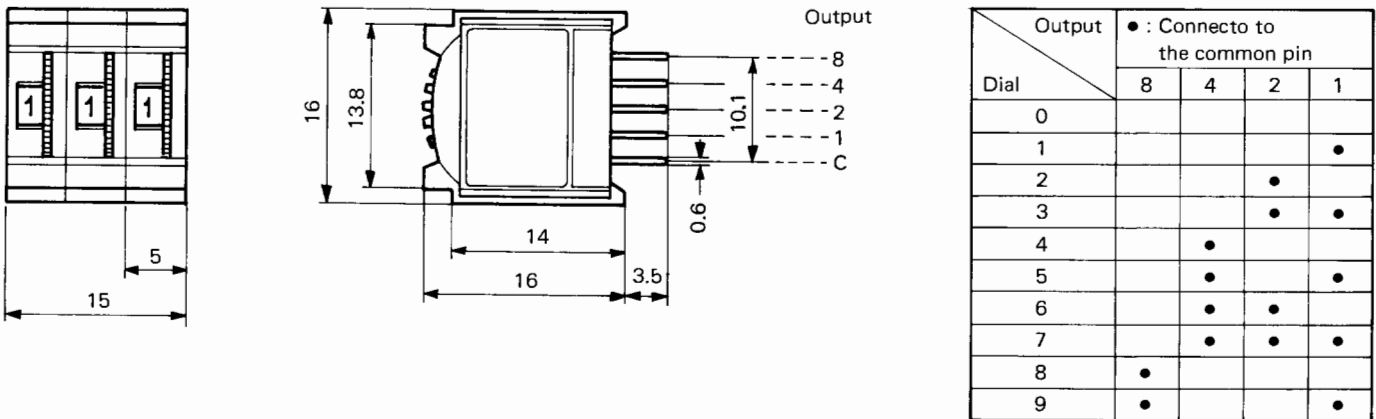


Fig. 7 Thumb wheel switch (S59-3401-05) (Switch unit S2)

## CIRCUIT DESCRIPTION

### Control circuit

A constant regulated 5V is obtained from voltage regulator Q19 : LV517. The 5C signal is available in both TX and RX modes, and is used as a reference voltage on the 6R and 5T AVR's.

The 6R output of Q20 : 2SC1037K is supplied to the RX section and the 5T output is supplied to the TX section. When the PTT switch is pressed, Q7 : 2SA1037K and Q8 : 2SA2412K are forward biased, and the TC line is grounded to place the radio in transmit mode.

The function of the power supply circuit is described in the table below.

	TC	Q23	Q26	Q22	Q24	6R	5T
RX	H	ON	OFF	ON	OFF	○	X
TX	L	OFF	ON	OFF	ON	X	○

Table 5 Function of power supply circuit

In unlock mode (when PLL is unlocked), the unlock signal "H" is felt at pin 1 of Q13 : TC5081AP. The unlock signal passes through D17 : MA152WA/2, to control Q23 and Q26 and switches the radio to RX. When a frequency is selected outside the normal amateur band, the anti-lock signal (AL) "H" is generated in the switch unit and is applied to D22 : 1SS133 of RF unit, which also places the radio in RX.

When the unlock or anti-lock signal is generated, an logic "H" is fed to the MUT pin (of the IF unit) through D17/2 or D18 : 1SS133 to stop AF amp operation.

During transmit, the 5T signal is replies to IF unit Q5 : 2SC2412K and Q1 : MC3359P via D4 : MA152WA to stop AF amp operation.

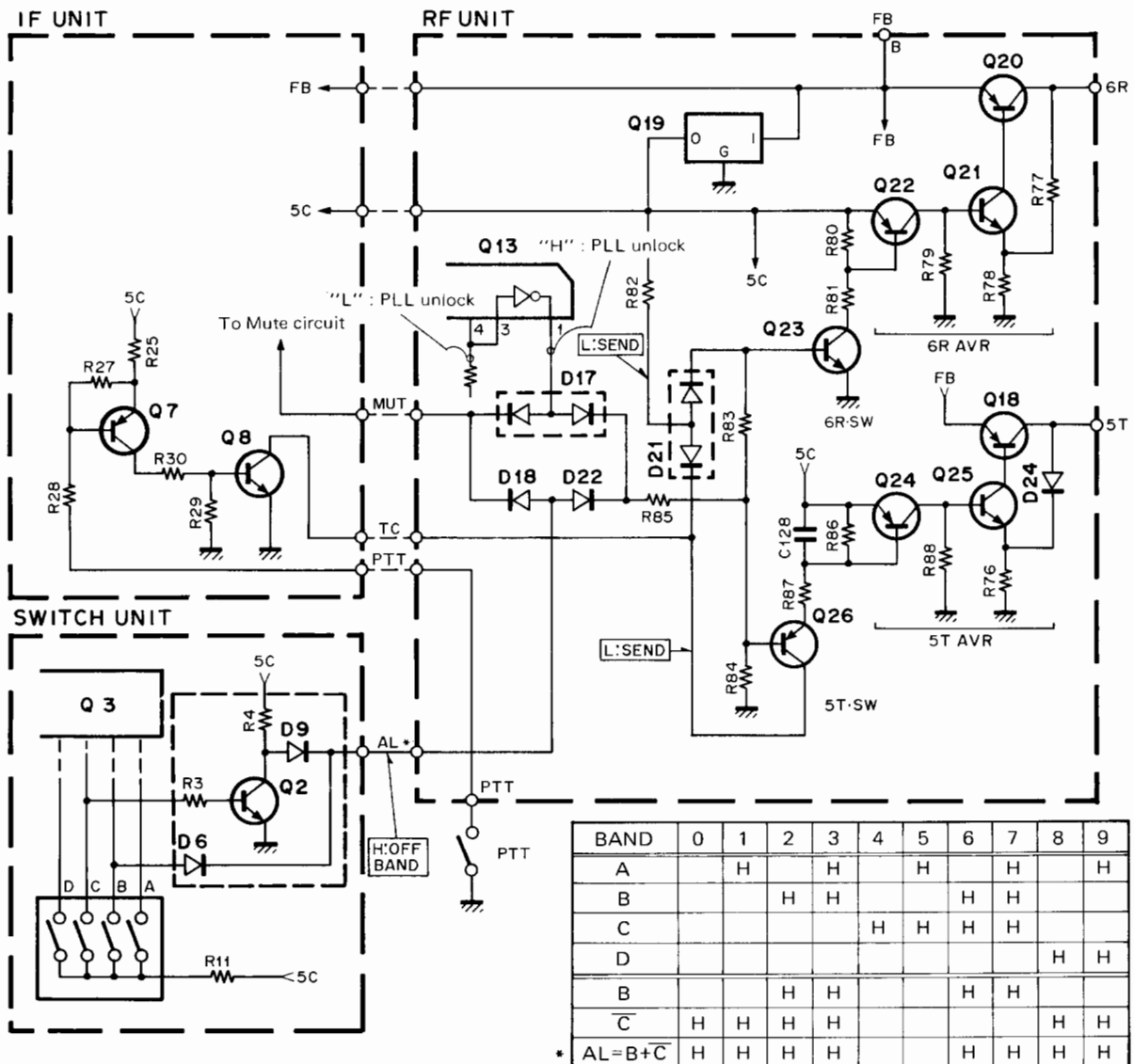
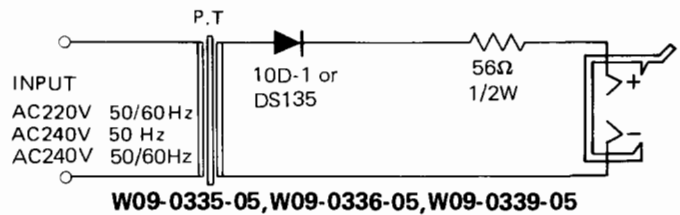
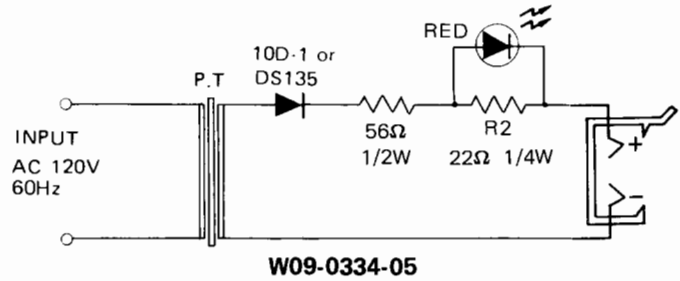


Fig. 8 Control circuit

## CIRCUIT DESCRIPTION/PACKING

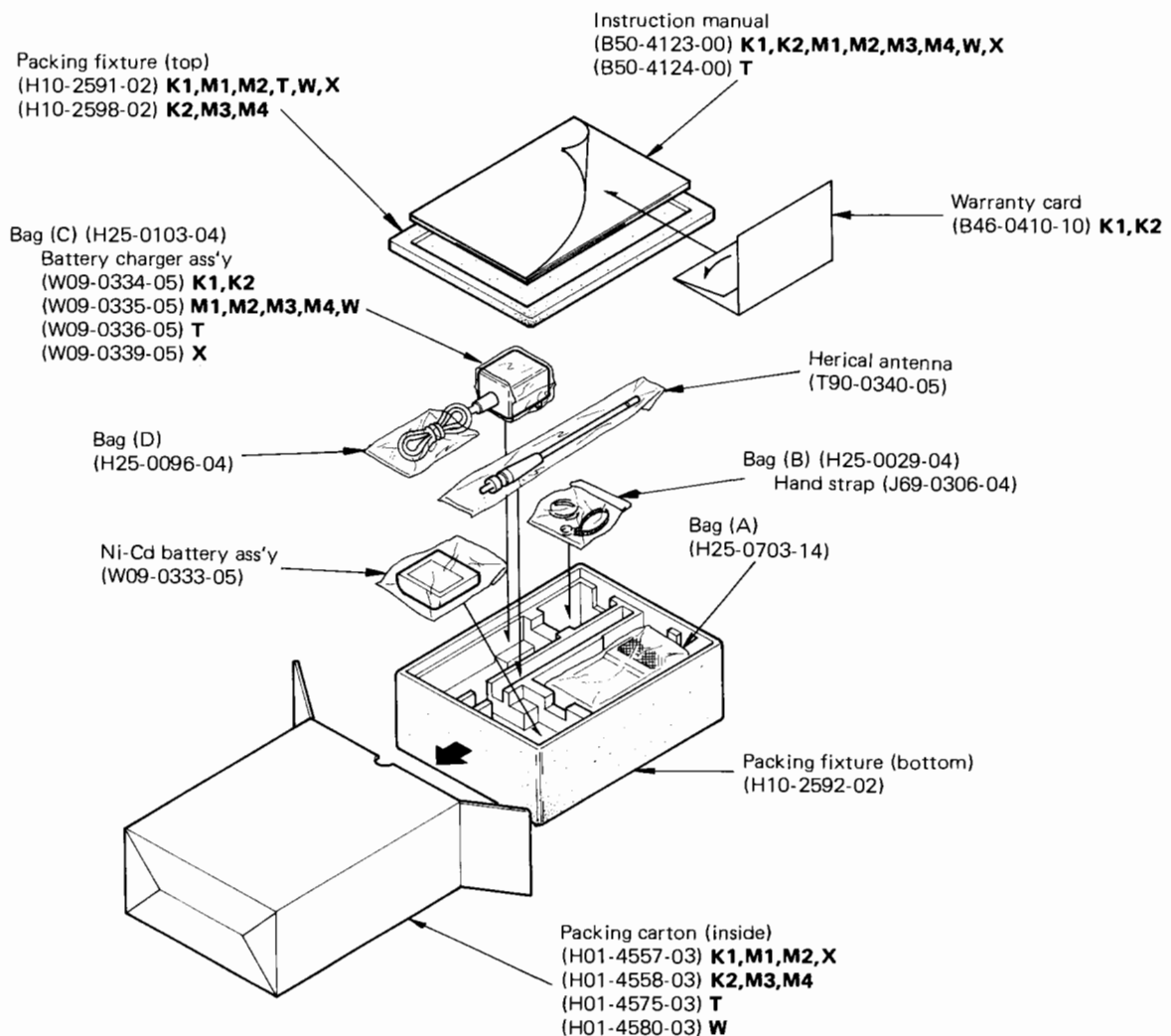
Parts No.	W09-0334-05	W09-0335-05	W09-0336-05	W09-0339-05
Input power	AC 120V 60Hz 3W or less	AC 220V 50/60Hz 3W or less	AC 240V 50Hz 3W or less	AC 240V 50/60Hz 3W or less
Output	DC 8.7V 32mA at 0mA/13.5V or less			
Weight	Approx. 120g	Approx. 210g		
Destination	U.S.A	Europe/Gen. M1-4	United Kingdom	Australia/ Newzealand
Ref'			TRIO Brand	

**Table 6 Charger specifications**



**Fig. 9 Charger schematic diagram**

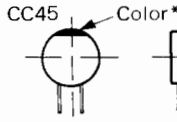
## PACKING



## PARTS LIST

### CAPACITORS

CC 45 TH 1H 220 J  
 1 2 3 4 5 6



#### Capacitor value

1 0 3 = 0.01μF

- 1 = Type ..... ceramic, electrolytic, etc.
- 2 = Shape ..... round, square, etc.
- 3 = Temp. coefficient
- 4 = Voltage rating
- 5 = Value
- 6 = Tolerance

- 0 1 0 = 1pF
- 1 0 0 = 10pF
- 1 0 1 = 100pF
- 1 0 2 = 1000pF = 0.001μF

2 2 0 = 22pF  
 1st number | Multiplier  
 2nd number

#### Temperature Coefficient

1st Word	C	L	P	R	S	T	U
Color*	Black	Red	Orange	Yellow	Green	Blue	Violet
ppm/°C	0	-80	-150	-220	-330	-470	-750

2nd Word	G	H	J	K	L
ppm/°C	± 30	± 60	± 120	± 250	± 500

Example CC45TH = -470±60 ppm/°C

#### Tolerance

Code	C	D	G	J	K	M	X	Z	P	No code
(%)	± 0.25	± 0.5	± 2	± 5	± 10	± 20	+ 40 - 20	+ 80 - 20	+ 100 - 0	10μF-10~+50 4.7μF-10~+75

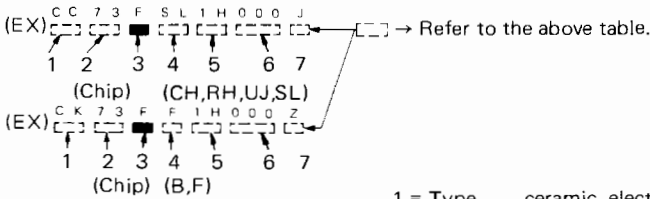
Code	B	C	D	F	G
(pF)	± 0.1	± 0.25	± 0.5	± 1	± 2

Less than 10 pF

#### Rating voltage

2nd word \ 1st word	A	B	C	D	E	F	G	H	J	K	V
0	1.0	1.25	1.6	2.0	2.5	3.15	4.0	5.0	6.3	8.0	-
1	10	12.5	16	20	25	31.5	40	50	63	80	35
2	100	125	160	200	250	315	400	500	630	800	-
3	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	-

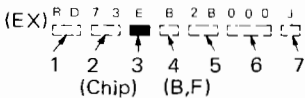
#### Chip capacitors



#### Dimension

Dimension code	L	W	T
Empty	5.6 ± 0.5	5.0 ± 0.5	Less than 2.0
E	3.2 ± 0.2	1.6 ± 0.2	Less than 1.25
F	2.0 ± 0.3	1.25 ± 0.2	Less than 1.25

#### Chip resistor (Carbon)



- 1 = Type ..... ceramic, electrolytic, etc.
- 2 = Shape ..... round, square, etc.
- 3 = Dimension
- 4 = Temp. coefficient
- 5 = Voltage rating
- 6 = Value
- 7 = Tolerance.

#### Carbon resistor (Normal type)

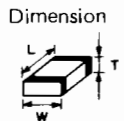


#### Dimension

Dimension code	L	W	T	Wattage
E	3.2 ± 0.2	1.6 ± 0.2	0.57	2B
F	2.0 ± 0.3	1.25 ± 0.2	0.45	2A

#### Rating wattage

Code	Wattage	Code	Wattage	Code	Wattage
2A	1 10W	2E	1 4W	3A	1W
2B	1 8W	2H	1 2W	3D	2W
2C	1 6W				



Model	Destination	Switch unit	RF unit	IF unit	Tone unit	Touch tone unit
TH-21A	K1 · M1	X41-1590-11	X44-1630-11	X48-1410-11		
	M2 · X	X41-1590-71	X44-1630-71			
TH-21AT	K2 · M3	X41-1590-11	X44-1630-11	X48-1410-11		A09-0402-05
	M4	X41-1590-71	X44-1630-71			
TH-21E	T	X41-1590-51	X44-1630-61	X48-1410-61	X41-1270-51	
	W	X41-1590-61			X41-1270-60	



PARTS LIST

TH-21A/AT/E GENERAL

N : New parts  
\* : Please note that parts are sometimes not in stock and it takes much time to deliver.

Table with columns: PART. NO, NOTE, NAME & DESCRIPTION, DISTINCTION (011-016), QUANTITY, and REFERENCE. NO. Rows include various parts like CASE (TOP), SP METAL, MODEL NAME PLATE, FCC PLATE, and CERAMIC CHIP CAP.

PARTS LIST

PART. NO	NOTE	NAME & DESCRIPTION	DISTINCTION & QUANTITY													REFERENCE. NO	
			011	012	021	022	023	024	051	061	071						
F20-0520-04	*	CUSHION(B) SP	1	1	1	1	1	1	1	1	1	1	1	1	1		
F20-0538-04	N*	INSULATING BOARD	1	1	1	1	1	1	1	1	1	1	1	1	1		
GL9PR24	N	LED RED	1	1	1	1	1	1	1	1	1	1	1	1	1		D, 101
G10-0633-04	N*	TAPE RF UNIT	2	2	2	2	2	2	2	2	2	2	2	2	2		
G13-0802-04	N*	CUSHION FOR JUNCTION	1	1	1	1	1	1	1	1	1	1	1	1	1		
G13-0626-04	*	CUSHION MIC	1	1	1	1	1	1	1	1	1	1	1	1	1		
G13-0802-04	N*	CUSHION FOR JUNCTION	2	2	2	2	2	2	2	2	2	2	2	2	2		
G13-0803-04	N*	CUSHION(B) FOR PTT	1	1	1	1	1	1	1	1	1	1	1	1	1		
H01-4557-13	N*	CARTON(INSIDE)	1														
H01-4558-13	N*	CARTON(INSIDE)	1														
H01-4557-13	N*	CARTON(INSIDE)			1												
H01-4558-13	N*	CARTON(INSIDE)				1											
H01-4575-13	N*	CARTON(INSIDE)															
H01-4580-13	N*	CARTON(INSIDE)															
H01-4557-13	N*	CARTON(INSIDE)															
H10-2591-02	N*	PACKING FIXTURE(TOP)	1		1												
H10-2592-02	N*	PACKING FIXTURE(BOTTOM)	1		1												
H10-2598-02	N*	PACKING FIXTURE(TOP)	1		1												
H25-0703-14	*	BAG(TH-21 BODY)140X190	1		1												
H25-0029-04	*	BAG(ACS) 60X110	1		1												
H25-0103-04	*	BAG(CHARGER) 125X250	1		1												
H25-0096-04	*	BAG(BATTERY) 100X110	1		1												
J25-3251-05	N	FLEXIBLE PC BOARD RF-IF	1		1												
J32-0785-04	N	ROUND BOSS M2X6	2		2												
J39-0409-14	*	MIC SPACER	1		1												
J69-0306-04	N	HAND STRAP (ACS)	1		1												
J69-0309-05	N	O RING AF.S&L	2		2												
K27-0468-04	N	PUSH KNOB(A) TONE	1		1												
K27-0469-04	N	PUSH KNOB(B) +5KHZ	1		1												
K29-3012-04	N	KNOB(A) AF	1		1												
K29-3013-04	N	KNOB(B) S&L	1		1												
K29-3014-04	N	PTT LEVER	1		1												
LR40872	N	IC	1		1												Q, 3
L78-0010-05	N	CRISTAL 3.58MHZ	1		1												X, 1
N09-0683-05	N	SPECIAL SCREW M2 X4	2		2												
N30-2004-41	N	PAN HD SCREW(SWITCH PC BOARD)	1		1												
N33-2005-45	N	ROUND FLAT SCREW(CASE:TOP)	3		3												
N33-2008-45	N	ROUND FLAT SCREW(CASE:TOP)	1		1												
N33-2005-45	N	BIND SCREW(CASE:BOTTOM)	2		2												
RD73FB2A473J	N	CHIP RES. 47K OHM 1/10W	5		5												R, 1, 2, 3, 4, 5
RD73FB2A154J	N	CHIP RES. 150KOHM 1/10W	1		1												R, 6
R12-3449-05	N	TRIM.POT 10K	1		1												VR, 1
T07-0235-05	N	SPEAKER	1		1												
T18-0054-05	N	EARPHONE (ACS)	1		1												
T90-0340-05	N	HERICAL ANTENNA(ACS)	1		1												
T91-0312-15	N	ELECTRIC CONDENSER MIC	1		1												
W09-0334-05	N	BATTERY CHARGER ASS'Y 120V	1		1												
W09-0335-05	N	BATTERY CHARGER ASS'Y 220V	1		1												

PARTS LIST

PART. NO	NOTE	NAME & DESCRIPTION	DISTINCTION & QUANTITY										REFERENCE. NO			
			011	012	021	022	023	024	051	061	071					
W09-0336-05	N	BATTERY CHARGER ASS'Y 240V										1				
W09-0335-05	N	BATTERY CHARGER ASS'Y 220V													1	
W09-0339-05	N	BATTERY CHARGER ASS'Y 240V														1
W09-0333-05	N	NI-CD BATTERY ASS'Y	1	1	1	1	1	1	1	1	1	1	1	1		
X41-1590-11	N*	SWITCH UNIT	1	1	1											
X41-1590-71	N*	SWITCH UNIT				1										
X41-1590-11	N*	SWITCH UNIT					1									
X41-1590-71	N*	SWITCH UNIT						1								
X41-1590-51	N*	SWITCH UNIT							1							
X41-1590-61	N*	SWITCH UNIT								1						
X41-1590-71	N*	SWITCH UNIT									1					
X44-1630-11	N*	RF UNIT	1	1	1											
X44-1630-71	N*	RF UNIT				1										
X44-1630-11	N*	RF UNIT					1									
X44-1630-71	N*	RF UNIT						1								
X44-1630-61	N*	RF UNIT							1							
X44-1630-71	N*	RF UNIT								1						
X48-1410-11	N*	IF UNIT	1	1	1	1	1	1	1	1	1	1	1	1	1	1
X48-1410-61	N*	IF UNIT														
X48-1410-11	N*	IF UNIT														
X52-1270-51	N*	RF UNIT														
X52-1270-60	N*	RF UNIT														
2SA1037K(Q)		CHIP TR.														Q / 2
2SA1162(Y)		CHIP TR.														Q / 2
2SC2412K(Q)		CHIP TR.														Q / 1
2SC2712(Y)		CHIP TR.														Q / 1

SEMICONDUCTOR

Item	Re- marks	Part No.
Diode		1S1555
		1S2588
		1S5133
		BA282
Vari-cap		MA856
		M1301
Zener Diode		1S2208
		ITT310TE
LED		MTZ6.8JB
		GL9PR24
Chip Diode		MA152WA
		MA152WK
IC		2SB698(E,F)
		2SC1947
		2SC2053
		2SC2347
		2SC2668(Y)
		2SC2671(H)
		2SA1037K(Q)
		2SA1037K(R)
		2SA1162(G)
		2SA1162(Y)
FET		2SC2412K(Q)
		2SC2712(Y)
		2SC2714(Y)
		2SK192A(Y)
		LR40872
		LVC517
IC		MC3359P
		NJM555M
		NJM4558M
		TA7331F
		TC5081AP
		TC5081P
IC		TC5082P
		TC9122P

PARTS LIST

SWITCH UNIT (X41-1590-XX) (-11 : K1,K2,M1,M3 -51 : T -61 : W -71 : M2,M4,X)

PART NO	NOTE	NAME & DESCRIPTION	DISTINCTION & QUANTITY							REFERENCE NO
			011	051	061	071				
CK73FB1H102K		CHIP CAP. 1000P 50V	14	14	14	14	14			R , 1, 2, 3, 4, 5, 6, 7 R , 8, 9, 10, 11, 12, 13, 14
L33-0682-05	N	CHOKE COIL	1	1	1	1	1			L , 1
L92-0110-05		FERRITE CORE	1	1	1	1	1			L , 2
MA152WK		CHIP DIODE	2	2	2	2	2			D , 4, 5
RD14CB2C101J		RES. CARBON 100 OHM 1/6W	1	1	1	1	1			R , 11
RD14CB2C101J		RES. CARBON 100 OHM 1/6W	1	1	1	1	1			R , 5
RD14CB2C103J		RES. CARBON 10K OHM 1/6W	1	1	1	1	1			R , 2
RD14CB2C103J		RES. CARBON 10K OHM 1/6W	2	2	2	2	2			R , 2, 4
RD73FB2A473J		CHIP RES. 47K OHM 1/10W	1	1	1	1	1			R , 1
RD73FB2A473J		CHIP RES. 47K OHM 1/10W	2	2	2	2	2			R , 1, 3
RD73FB2A102J		CHIP RES. 1K OHM 1/10W	1	1	1	1	1			R , 6
R05-3427-15	N	POTENTIOMETER 10K (B) WITH SW	1	1	1	1	1			VR , 1
R05-3428-05	N	POTENTIOMETER 10K (B)	1	1	1	1	1			VR , 2
R92-0670-05		CHIP RES. 0 OHM	3	1	1	1	1			R , 7, 8, 9
R92-0670-05		CHIP RES. 0 OHM	4	4	4	4	4			R , 7, 8, 9, 10
S40-2445-05		PUSH SWITCH(SELF LOCK)	2	2	2	2	2			S , 3, 4
S40-2445-05		PUSH SWITCH(SELF LOCK)			1					S , 3
S40-2446-05		PUSH SWITCH(NON LOCK)			1					S , 4
S59-3401-05	N	THUMB WHEEL SWITCH	1	1	1	1	1			S , 2
TC9122P		IC	1	1	1	1	1			Q , 3
1SS133		DIODE			2					D , 6, 9
1SS133		DIODE			2					D , 6, 7
2SC2412K(Q)		CHIP TR.	1	2	2	2	2			Q , 1
2SC2412K(Q)		CHIP TR.								Q , 1, 2
2SC2712(Y)		CHIP TR.								Q , 1
2SC2712(Y)		CHIP TR.								Q , 1, 2

PARTS LIST

RF UNIT (X44-1630-XX) (-11 : K1,K2,M1,M3 -61 : T,W -71 : M2,M4,X)

PART_NO	NOTE	NAME & DESCRIPTION	DISTINCTION & QUANTITY				REFERENCE_NO
			011	061	071		
BA282		DIODE	4				L , 10, 11, 12, 13
BA282		DIODE		4			L , 10, 12, 13, 23
CC45CH1H090D		CERAMIC 9P 50V	1	1	1		C , 51
CC45CH1H150J		CERAMIC 15P 50V	1	1	1		C , 52
CC73FCH1H330J		CHIP CAP. 33P 50V	2	2	2		C , 28, 48
CC73FCH1H100D		CHIP CAP. 10P 50V	12		12		C , 8, 12, 22, 25, 27, 32, 62
CC73FCH1H100D		CHIP CAP. 10P 50V		11			C , 8, 12, 22, 25, 27, 32, 63
CC73FCH1H390J		CHIP CAP. 39P 50V	3	3	3		C , 64, 109, 113, 118
CC73FCH1H010C		CHIP CAP. 1P 50V	4	4	4		C , 42, 79, 80
CC73FCH1H1R5C		CHIP CAP. 1.5P 50V	2	2	2		C , 26, 33, 92, 117
CC73FCH1H470J		CHIP CAP. 47P 50V	2	2	2		C , 11, 13
CC73FCH1H120J		CHIP CAP. 12P 50V	2	2	2		C , 35, 74
CC73FCH1H560J		CHIP CAP. 56P 50V	3	3	3		C , 99, 116
CC73FCH1H030C		CHIP CAP. 3P 50V	1	1	1		C , 70, 72, 103
CC73FCH1H680J		CHIP CAP. 68P 50V	2	2	2		C , 49
CC73FCH1H050C		CHIP CAP. 5P 50V	5	5	5		C , 40, 69
CC73FCH1H150J		CHIP CAP. 15P 50V	2	2	2		C , 73, 75, 76, 100, 105
CC73FSL1H121J		CHIP CAP. 120P 50V	3	3	3		C , 104, 158
CC73FCH1H070D		CHIP CAP. 7P 50V	2	2	2		C , 3, 5, 119
CC73FCH1H180J		CHIP CAP. 18P 50V	3	3	3		C , 4, 14
CC73FCH1H090D		CHIP CAP. 9P 50V	1	1	1		C , 86, 87, 98
CC73FCH1H220J		CHIP CAP. 22P 50V	1	1	1		C , 94
CC73FCH1H270J		CHIP CAP. 27P 50V	2	2	2		C , 39, 50
CE04CW1A330M		ELECTRO 33 10V	1	1	1		C , 133
CE04CW1A01M		ELECTRO 100 10V	2	2	2		C , 132, 155
CE04CW1C100M		ELECTRO 10 16V	1	1	1		C , 88
CE04CW1C4R7M		ELECTRO 4.7 16V	2	2	2		C , 45, 159
CE04CW1C470M		ELECTRO 47 16V	1	1	1		C , 120
CE04CW1E3R3M		ELECTRO 3.3 25V	1	1	1		C , 134
CE04CW1V2R2M		ELECTRO 2.2 35V	1	1	1		C , 156
CE04CW0J100M		ELECTRO 10 6.3V	1	1	1		C , 91
CE04CW1H010M		ELECTRO 1 50V	1	1	1		C , 121
CE04CW0J470M		ELECTRO 47 6.3V	1	1	1		C , 122
CE04CW1E4R7M		ELECTRO 4.7 25V	1	1	1		C , 128
CK73FB1H102K		CHIP CAP. 1000P 50V	64	64	64		C , 1, 7, 9, 10, 18, 19, 21
CK73FB1H102K		CHIP CAP. 1000P 50V					C , 23, 24, 29, 30, 31, 36, 37
CK73FB1H102K		CHIP CAP. 1000P 50V					C , 38, 41, 44, 46, 47, 57, 67
CK73FB1H102K		CHIP CAP. 1000P 50V					C , 68, 71, 77, 78, 82, 84, 85
CK73FB1H102K		CHIP CAP. 1000P 50V					C , 89, 90, 93, 95, 96, 97, 106
CK73FB1H102K		CHIP CAP. 1000P 50V					C , 107, 108, 110, 111, 112, 114, 115
CK73FB1H102K		CHIP CAP. 1000P 50V					C , 125, 126, 129, 130, 131, 135, 136
CK73FB1H222K		CHIP CAP. 2200P 50V	1	1	1		C , 137, 138, 139, 140, 141, 142, 144
CK73FB1H472K		CHIP CAP. 4700P 50V	4	4	4		C , 145, 146, 147, 148, 149, 152, 153
CK73FB1E103K		CHIP CAP. 0.01 25V	10	10	10		C , 157
CK73FB1E23K		CHIP CAP. 0.022 25V	2	2	2		C , 83
CK73FB1H471K		CHIP CAP. 470P 50V	2	2	2		C , 15, 17, 101, 102
C05-0327-05		TRIMMER 20P	2	2	2		C , 53, 54, 55, 56, 58, 59, 60
C05-0320-05		TRIMMER 30P	5	5	5		C , 65, 66, 154
C90-0891-05		TANTALUM 4.7 16V	1	1	1		C , 20, 150

# TH-21A/AT/E PARTS LIST

PART NO	NOTE	NAME & DESCRIPTION	DISTINCTION & QUANTITY				REFERENCE NO
			011	041	071		
E13-0165-05	N	RCA RECEPTACLE ANT.-J	1	1	1	J	1
F11-0873-04	N*	SHIELD COVER (VCO)	1	1	1		
ITT310TE		VOLTAGE VARIABLE	1	1	1	D	14
LVC517		IC	1	1	1	Q	19
L19-0354-05	N	WIDE BAND TRANS 12T	1	1	1	L	33
L32-0672-05		OSC COIL	4	4	4	L	19, 20, 21, 22
L34-2226-05	N	TUNING COIL VCO 70MHZ	1	1	1	L	30
L34-2223-05	N	TUNING COIL 140MHZ	11	11	11	L	6, 7, 8, 10, 11, 12, 13
L34-2224-05	N	TUNING COIL 16.3MHZ	1	1	1	L	9
L34-2225-05	N	TUNING COIL 140MHZ	1	1	1	L	5
L34-0892-05		COIL 2 10T	1	1	1	L	4
L34-0893-05		COIL 3 4T	1	1	1	L	2
L34-0894-05		COIL 3 5T	2	2	2	L	16, 17
L34-0895-05		COIL 3 6T	1	1	1	L	14
L34-1061-05		COIL 3 2T	1	1	1	L	15
L34-1105-05	N	COIL 3 4T ANT	1	1	1	L	1
L40-3382-17		INDUCTOR 0.33UH	1	1	1	L	34
L40-1092-17		INDUCTOR 1UH	2	2	2	L	3, 18
L40-3391-17		INDUCTOR 3.3UH	1	1	1	L	32
L40-5691-17		INDUCTOR 5.6UH	1	1	1	L	31
L40-1501-17		INDUCTOR 15UH	1	1	1	L	28
L40-4701-17		INDUCTOR 47UH	5	5	5	L	29, 40, 41, 42, 43
L40-1011-17		INDUCTOR 100UH	2	2	2	L	27, 37
L71-0246-05	N	MCF 16.3MHZ	1	1	1	F	1
L77-1234-05	N	XTAL 10.24MHZ	1	1	1	X	1
L77-1235-05	N	XTAL 30.925MHZ RX(S)	1	1	1	X	2
L77-1236-05	N	XTAL 35.000MHZ TX(S)	1	1	1	X	4
L77-1239-05	N	XTAL 35.150MHZ TX(+)	1	1	1	X	3
L77-1237-05	N	XTAL 30.775MHZ RX(-)	1	1	1	X	3
L77-1239-05	N	XTAL 35.150MHZ TX(+)	1	1	1	X	3
L77-1238-05	N	XTAL 35.150MHZ TX(-)	1	1	1	X	5
L92-0110-05	N	FERRITE CORE 34.850MHZ TX(-)	2	2	2	L	38, 39
MA152WA		CHIP DIODE	2	2	2	D	17, 21
MA856		DIODE	5	5	5	D	6, 7, 8, 9, 15
MI301		DIODE	1	1	1	D	4
RD14CB2C220J		RES. CARBON 22 OHM 1/6W	1	1	1	R	26
RD14CB2C470J		RES. CARBON 47 OHM 1/6W	1	1	1	R	22
RD14BB2C560J		RES. CARBON 56 OHM 1/6W	2	2	2	R	9, 47
RD14CB2C223J		RES. CARBON 22K OHM 1/6W	1	1	1	R	58
RD14BB2C822J		RES. CARBON 8.2KOHM 1/6W	1	1	1	R	13
RD14CB2C103J		RES. CARBON 10K OHM 1/6W	1	1	1	R	56
RD14BB2C222J		RES. CARBON 2.2KOHM 1/6W	1	1	1	R	34
RD14BB2C392J		RES. CARBON 3.9KOHM 1/6W	1	1	1	R	35
RD14BB2C223J		RES. CARBON 22K OHM 1/6W	1	1	1	R	16
RD14CB2C472J		RES. CARBON 4.7KOHM 1/6W	2	2	2	R	99, 100
RD14BB2C104J		RES. CARBON 100KOHM 1/6W	1	1	1	R	93
RD14BB2C334J		RES. CARBON 330KOHM 1/6W	1	1	1	R	14
RD73FB2A330J		CHIP RES. 33 OHM 1/10W	1	1	1	R	20
RD73FB2A271J		CHIP RES. 270 OHM 1/10W	1	1	1	R	27
RD73FB2A222J		CHIP RES. 2.2KOHM 1/10W	6	6	6	R	3, 8, 12, 49, 57, 66
RD73FB2A103J		CHIP RES. 10K OHM 1/10W	8	8	8	R	48, 55, 62, 63, 78, 79, 85

PARTS LIST

PART. NO	NOTE	NAME & DESCRIPTION	DISTINCTION & QUANTITY				REFERENCE. NO
			011	061	071		
RD73FB2A473J		CHIP RES. 47K OHM 1/10W	4	4	4	R , 88	
RD73FB2A331J		CHIP RES. 330 OHM 1/10W	2	2	2	R , 15, 29	
RD73FB2A563J		CHIP RES. 56K OHM 1/10W	1	1	1	R , 43	
RD73FB2A470J		CHIP RES. 47 OHM 1/10W	1	1	1	R , 17	
RD73FB2A123J		CHIP RES. 12K OHM 1/10W	2	2	2	R , 89, 92	
RD73FB2A560J		CHIP RES. 56 OHM 1/10W	1	1	1	R , 7	
RD73FB2A471J		CHIP RES. 470 OHM 1/10W	4	4	4	R , 4, 6, 46, 50	
RD73FB2A104J		CHIP RES. 100KOHM 1/10W	1	1	1	R , 54	
RD73FB2A272J		CHIP RES. 2.7KOHM 1/10W	2	2	2	R , 2, 67	
RD73FB2A153J		CHIP RES. 15K OHM 1/10W	2	2	2	R , 19, 59	
RD73FB2A154J		CHIP RES. 150KOHM 1/10W	1	1	1	R , 72	
RD73FB2A332J		CHIP RES. 3.3KOHM 1/10W	1	1	1	R , 77	
RD73FB2A101J		CHIP RES. 100 OHM 1/10W	7	7	7	R , 1, 10, 18, 21, 64, 73, 73	
RD73FB2A681J		CHIP RES. 680 OHM 1/10W	1	1	1	R , 11	
RD73FB2A821J		CHIP RES. 820 OHM 1/10W	2	2	2	R , 45, 70	
RD73FB2A183J		CHIP RES. 18K OHM 1/10W	1	1	1	R , 44	
RD73FB2A224J		CHIP RES. 220KOHM 1/10W	2	2	2	R , 51, 82	
RD73FB2A472J		CHIP RES. 4.7KOHM 1/10W	3	3	3	R , 76, 80, 86	
RD73FB2A334J		CHIP RES. 330KOHM 1/10W	1	1	1	R , 65	
RD73FB2A223J		CHIP RES. 22K OHM 1/10W	2	2	2	R , 81, 87	
RD73FB2A2R2J		CHIP RES. 2.2 OHM 1/10W	1	1	1	R , 96	
RD73FB2A122J		CHIP RES. 1.2KOHM 1/10W	3	3	3	R , 42, 91, 61	
RD73FB2A562J		CHIP RES. 5.6KOHM 1/10W	7	7	7	R , 38, 39, 40, 41, 61, 68, 95	
RD73FB2A121J		CHIP RES. 120 OHM 1/10W	2	2	2	R , 25, 69	
RD73FB2A151J		CHIP RES. 150 OHM 1/10W	1	1	1	R , 24	
RD73FB2A100J		CHIP RES. 10 OHM 1/10W	1	1	1	R , 23	
RD73FB2A220J		CHIP RES. 22 OHM 1/10W	1	1	1	R , 28	
RD73FB2A822J		CHIP RES. 8.2KOHM 1/10W	3	3	3	R , 5, 36, 37	
R92-0670-05		CHIP RES. 0 OHM	2	2	2	R , 97, 98	
R92-0150-05		JUMPER WIRE	1	1	1	JP , 1	
S50-1425-05	N	TACT SWITCH PTT	1	1	1	S , 1	
TC5082P		IC	1	1	1	Q , 12	
TC5081AP	N	IC	1	1	1	Q , 13	
1S5133		DIODE	4	4	4	D , 2, 19, 20, 24	
1S5133		DIODE	6	6	6	D , 2, 18, 19, 20, 22, 24	
1S1555		DIODE	1	1	1	D , 3	
1S2588		DIODE	1	1	1	D , 5	
1S2208		VOLTAGE VARIABLE	1	1	1	D , 16	
2SA1037K(Q)	N	CHIP TR.	2	2	2	Q , 20, 26	
2SA1162(Y)		CHIP TR.	2	2	2	Q , 20, 26	
2SA1037K(R)		CHIP TR.	2	2	2	Q , 22, 24	
2SA1162(IGR)		CHIP TR.	1	1	1	Q , 22, 24	
2SB698(E,F)		TR	1	1	1	Q , 18	
2SC2714(Y)		TR	4	4	4	Q , 4, 9, 14, 15	
2SC1947		TR	1	1	1	Q , 8	
2SC2053		TR	1	1	1	Q , 7	
2SC2347		TR	1	1	1	Q , 6	
2SC2668(Y)		TR	5	5	5	Q , 2, 5, 10, 11, 17	
2SC2671(H)		TR	2	2	2	Q , 1, 16	
2SC2412K(Q)		CHIP TR.	4	4	4	Q , 21, 23, 25, 27	
2SC2712(Y)		CHIP TR.	4	4	4	Q , 21, 23, 25, 27	
2SK192A(Y)		FET	1	1	1	Q , 3	

# TH-21A/AT/E PARTS LIST

## IF UNIT (X48-1410-XX) (-11 : K1, K2, M1, M2, M3, M4, X -61 : T, W)

PART. NO	NOTE	NAME & DESCRIPTION	DISTINCTION & QUANTITY		REFERENCE. NO
			O11,061		
CC73FCH1H270J		CHIP CAP. 27P 50V	1	1	C / 3
CC73FSL1H101J		CHIP CAP. 100P 50V	5	5	C / 2, 16, 36, 37, 38
CC73FSL1H151J		CHIP CAP. 150P 50V	1	1	C / 9
CC73FSL1H391J		CHIP CAP. 390P 50V	1	1	C / 47
CE04CW0J330M		ELECTRO 33 6.3V	1	1	C / 43
CE04CW1A100M		ELECTRO 10 10V	2	2	C / 40, 52
CE04CW1C4R7M		ELECTRO 4.7 16V	1	1	C / 33
CE04CW1V2R2M		ELECTRO 2.2 35V	4	4	C / 19, 21, 34, 44
CK45B1H102K		CERAMIC 1000P 50V	1	1	C / 1
CK73FB1H102K		CHIP CAP. 1000P 50V	20	20	C / 7, 12, 14, 15, 20, 29, 30, 31, 32, 35, 42, 49, 50, 51, 53, 54, 55, 56, 57, 58
CK73FB1E273K		CHIP CAP. 0.027 25V	1	1	C / 23
CK73FB1H272K		CHIP CAP. 2700P 50V	1	1	C / 45
CK73FF1E473Z		CHIP CAP. 0.047 25V	3	3	C / 4, 8, 11
CK73FB1H682K		CHIP CAP. 6800P 50V	1	1	C / 46
CK73FB1E223K		CHIP CAP. 0.022 25V	2	2	C / 13, 17
C90-0888-05		TANTALUM 0.1 16V	1	1	C / 39
C90-2006-05	N	TANTALUM 0.22 16V	1	1	C / 10
C90-0894-05		TANTALUM 0.33 16V	1	1	C / 48
C90-2007-05	N	TANTALUM 0.47 16V	1	1	C / 18
C90-2012-05		ELECTRO 3.3 10V	3	3	C / 22
C90-0891-05		TANTALUM 4.7 16V	1	1	C / 25, 26, 28
C91-0488-05		CERAMIC 0.1	2	2	C / 5, 6
C91-0430-05		LAYER CAP. 0.047	1	1	C / 41
C91-1035-05		FILM CAP. 0.22 63V	1	1	C / 27
E11-0420-05	N	MIC JACK	1	1	J / 2
E11-0421-05	N	PHONE JACK	1	1	J / 1
L34-2217-05		TUNING COIL 455KHZ	1	1	L / 1
L72-0335-05		CERAMIC FILTER CFU-455E	1	1	F / 1
L77-1240-05	N	CRYSTAL 15.845MHZ	1	1	X / 1
MA152MA	N	CHIP DIODE	1	1	D / 4
MC3559P		IC	1	1	Q / 1
MTZ6.8JB		ZENER DIODE 6.8V	1	1	D / 3
NJM4558M		IC	1	1	Q / 6
RD14CB2C472J		RES. CARBON 4.7KOHM 1/6W	2	2	R / 30, 31
RD14CB2C103J		RES. CARBON 10K OHM 1/6W	2	2	R / 15, 17
RD14CB2C104J		RES. CARBON 100KOHM 1/6W	1	1	R / 9
RD14CB2C684J		RES. CARBON 680KOHM 1/6W	1	1	R / 20
RD73FB2A102J		CHIP RES. 1K OHM 1/10W	3	3	R / 14, 16, 19
RD73FB2A152J		CHIP RES. 1.5KOHM 1/10W	1	1	R / 29
RD73FB2A473J		CHIP RES. 47K OHM 1/10W	4	4	R / 18, 36, 38, 39
RD73FB2A222J		CHIP RES. 2.2KOHM 1/10W	4	4	R / 4, 26, 33, 34
RD73FB2A823J		CHIP RES. 82K OHM 1/10W	1	1	R / 13
RD73FB2A273J		CHIP RES. 27K OHM 1/10W	1	1	R / 35
RD73FB2A470J		CHIP RES. 47 OHM 1/10W	1	1	R / 12
RD73FB2A104J		CHIP RES. 100KOHM 1/10W	1	1	R / 10
RD73FB2A822J		CHIP RES. 8.2KOHM 1/10W	1	1	R / 5
RD73FB2A334J		CHIP RES. 330KOHM 1/10W	1	1	R / 6
RD73FB2A103J		CHIP RES. 10K OHM 1/10W	4	4	R / 1, 7, 8, 27
RD73FB2A101J		CHIP RES. 100 OHM 1/10W	1	1	R / 11



PARTS LIST

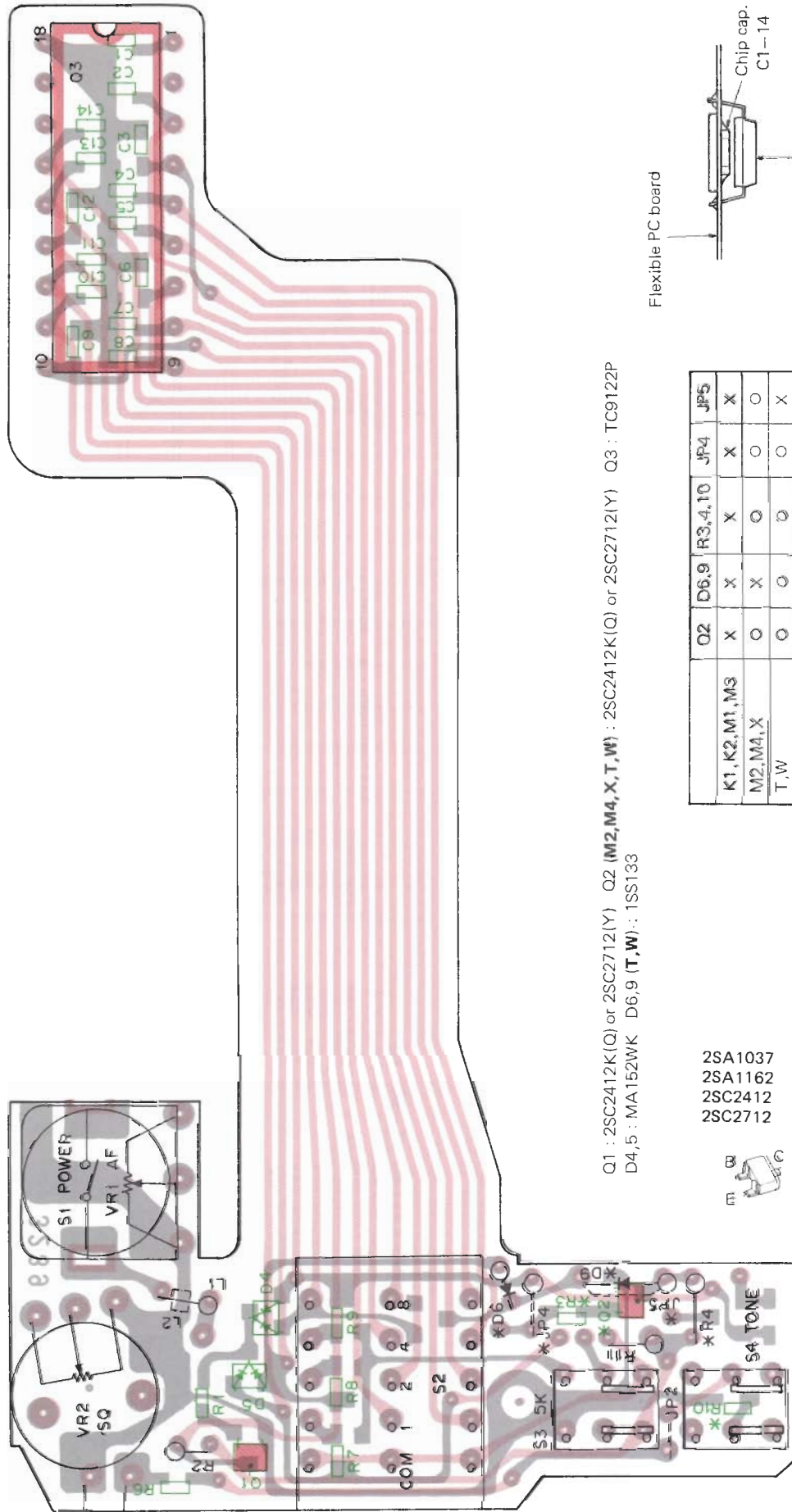
PART NO	NOTE	NAME & DESCRIPTION	DISTINCTION & QUANTITY		REFERENCE NO
			011	061	
RD73FB2A223J		CHIP RES. 22K OHM 1/10W	6		R , 2, 3, 22, 23, 24, 37
RD73FB2A221J		CHIP RES. 220 OHM 1/10W	2		R , 25, 32
RD73FB2A333J		CHIP RES. 33K OHM 1/10W	2		R , 21, 28
R12-3449-05	N	TRIM.POT 10K	1		VR , 1
R90-0526-05		RESISTOR BLOCK 27K OHM X4	1		RB , 1
R92-1061-05		JUMPER WIRE	1		JP , 1, 2, 6, 7, 8
R92-1061-05		JUMPER WIRE	5		JP , 3, 4, 6, 7, 8
S31-1414-05		SLIDE SWITCH HI - LO	1		S , 1
S31-2409-05	N	SLIDE SWITCH OFFSET	1		S , 2
TA7331F	N	IC	1		Q , 2
1N60A		DIODE	2		D , 1, 2
2SA1037K(Q)	N	CHIP TR.	1		Q , 7
2SA1162(Y)		CHIP TR.	1		Q , 7
2SB698(E,F)		TR	1		Q , 3
2SC2412K(Q)	N	CHIP TR.	3		Q , 4, 5, 8
2SC2712(Y)	N	CHIP TR.	3		Q , 4, 5, 8

TONE UNIT (X41-1270-XX) (-51 : T -60 : W)

PART NO	NOTE	NAME & DESCRIPTION	DISTINCTION & QUANTITY		REFERENCE NO
			051	060	
CE04CW1C100M		ELECTRO 10 16V	1		C , 7
CK73FB1H392K		CHIP CAP. 3900P 25V	1		C , 6
CK73FB1E103K		CHIP CAP. 0.01 25V	3		C , 2, 4, 5
CK73EB1E333K		CHIP CAP. 0.033 25V	1		C , 3
NJM555M	N	IC	1		Q , 1
RD73FB2A472J		CHIP RES. 4.7KOHM 1/10W	1		R , 2
RD73FB2A123J		CHIP RES. 12K OHM 1/10W	2		R , 4, 6
RD73FB2A333J		CHIP RES. 33K OHM 1/10W	1		R , 7
RD73FB2A473J		CHIP RES. 47K OHM 1/10W	1		R , 5
RD73FB2A913J		CHIP RES. 91K OHM 1/10W	1		R , 3
R12-3452-05	N	TRIM.POT 20K	1		VR , 1
R92-0670-05		CHIP RES. 0 OHM	1		R , 8

# TH-21A/AT/E PC BOARD VIEW

SWITCH UNIT (X41-1590-XX) (-11 : K1,K2,M1,M3  
-51 : T -61 : W -71 : M2,M4,X) Component side view



Q1 : 2SC2412K(Q) or 2SC2712(Y) Q2 (M2,M4,X,T,W) : 2SC2412K(Q) or 2SC2712(Y) Q3 : TC9122P  
D4,5 : MA152WK D6,9 (T,W) : 1SS133

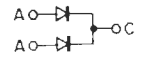
	Q2	D6,9	R3,4,10	JP4	JP5
K1, K2, M1, M3	X	X	X	X	X
M2, M4, X	O	X	O	O	O
T, W	O	O	O	O	X

O : Used, X : Not used

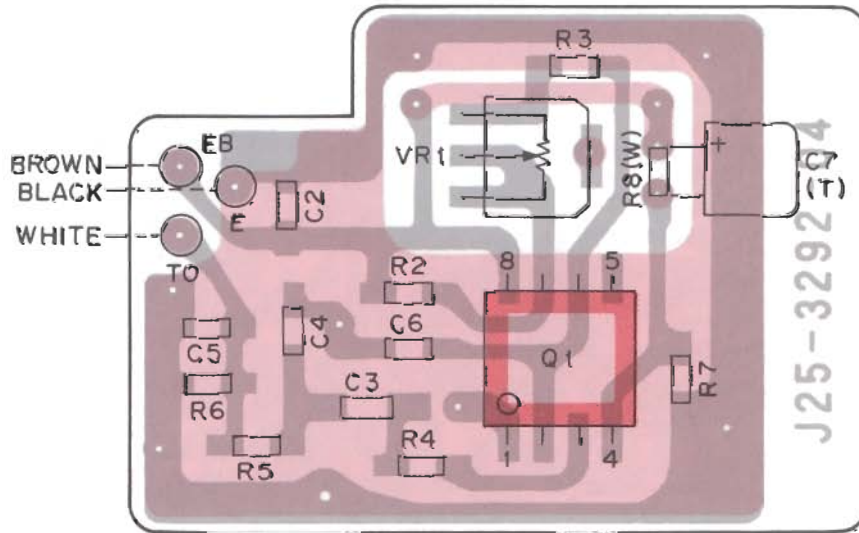
2SA1037  
2SA1162  
2SC2412  
2SC2712



MA152WK

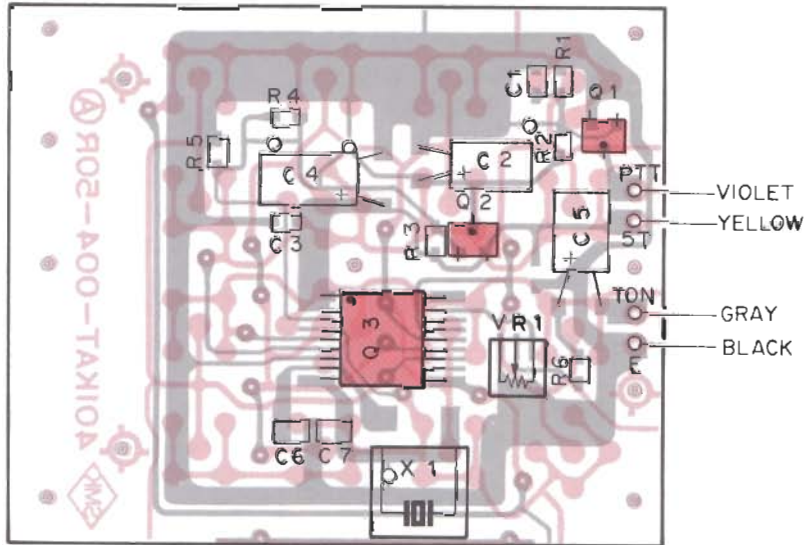


TONE UNIT (X52-1270-XX) (-51 : T -60 : W) Foil side view



Q1 : NJM555M

DTMF UNIT (TH-21AT ONLY) Foil side view



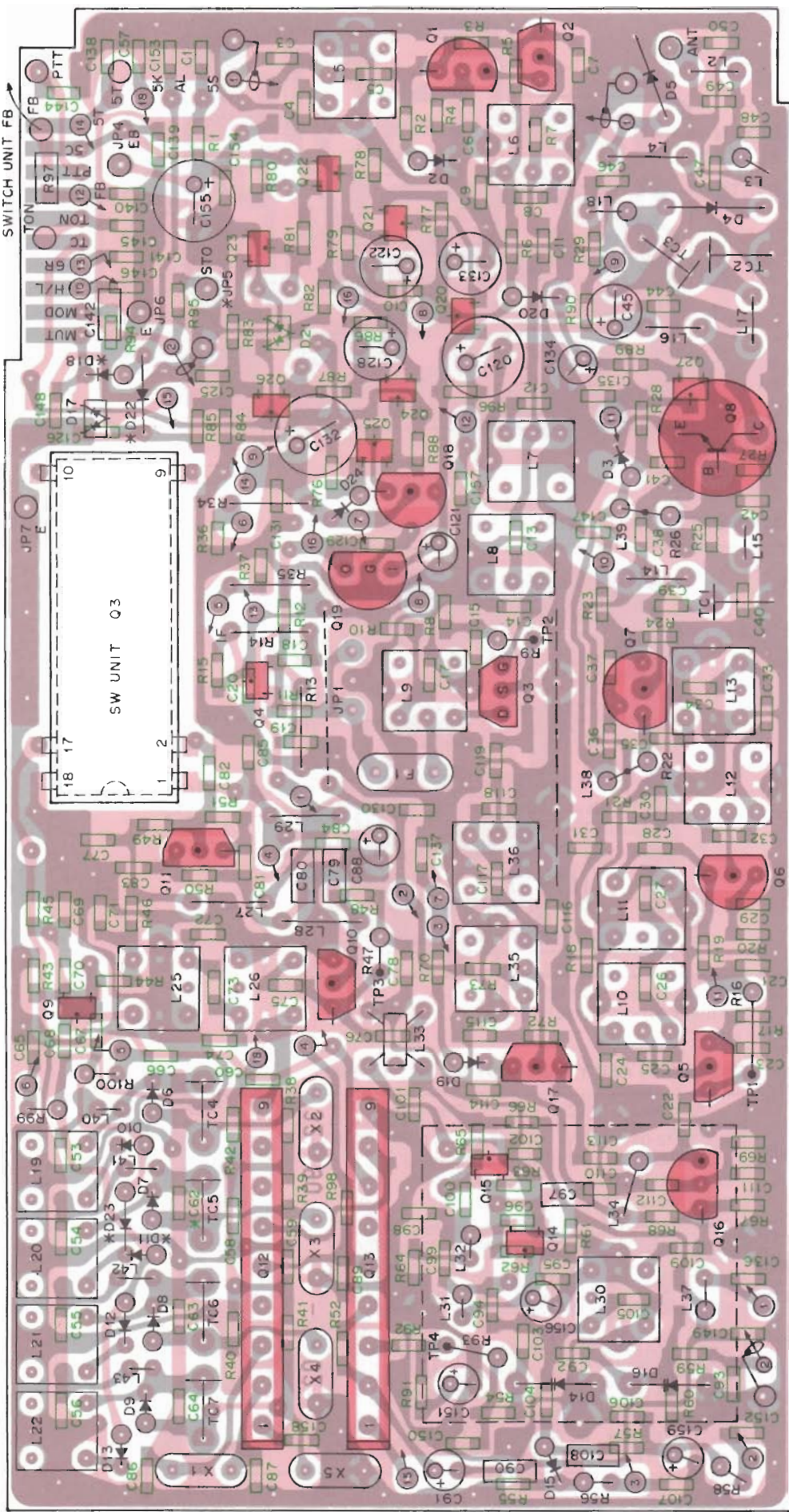
Q1 : 2SC2412K(Q) or 2SC2712(Y)  
 Q2 : 2SA1037K(O) or 2SA1162(Y)  
 Q3 : LR40872

CASE (TOP) ASS'Y (A09-0402-05) WITH DTMF:

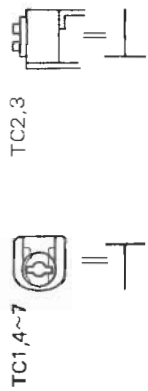
Parts No.	Re- marks	Description	Qty	Ref. No.
A09-0672-01	N*	Case (Top) 146MHz, KENWOOD		
B42-2344-08	N*	Key board plate		
CC73CH1H300J		Chip cap. 30P 50V	2	C6,7
CE04CW0J100M		Electro 10 6.3V	2	C2,4
CE04CE1C4R7M		Electro 4.7 16V	1	C5
CK73FB1E103K		Chip cap. 0.01 25V	2	C1,3
LR40872	N	IC	1	O3
L78-0010-05	N	Crystal 3.58MHz	1	X1
RD73FB2A473J		Chip res. 47kΩ 1/10W	5	R1-5
RD73FB2A154J		Chip res. 150kΩ 1/10W	1	R6
R12-3449-05		Trim. pot. 10kΩ	1	VR1
2SA1037K(O) or 2SA1162(Y)		Chip TR.	1	Q2
2SC2412K(Q) or 2SC2712(Y)		Chip TR.	1	Q1

# TH-21A/AT/E PC BOARD VIEW

RF UNIT (X44-1630-XX) (-11 : K1,K2,M1,M3 -61 : T,W -71 : M2,M4,X) Component side view



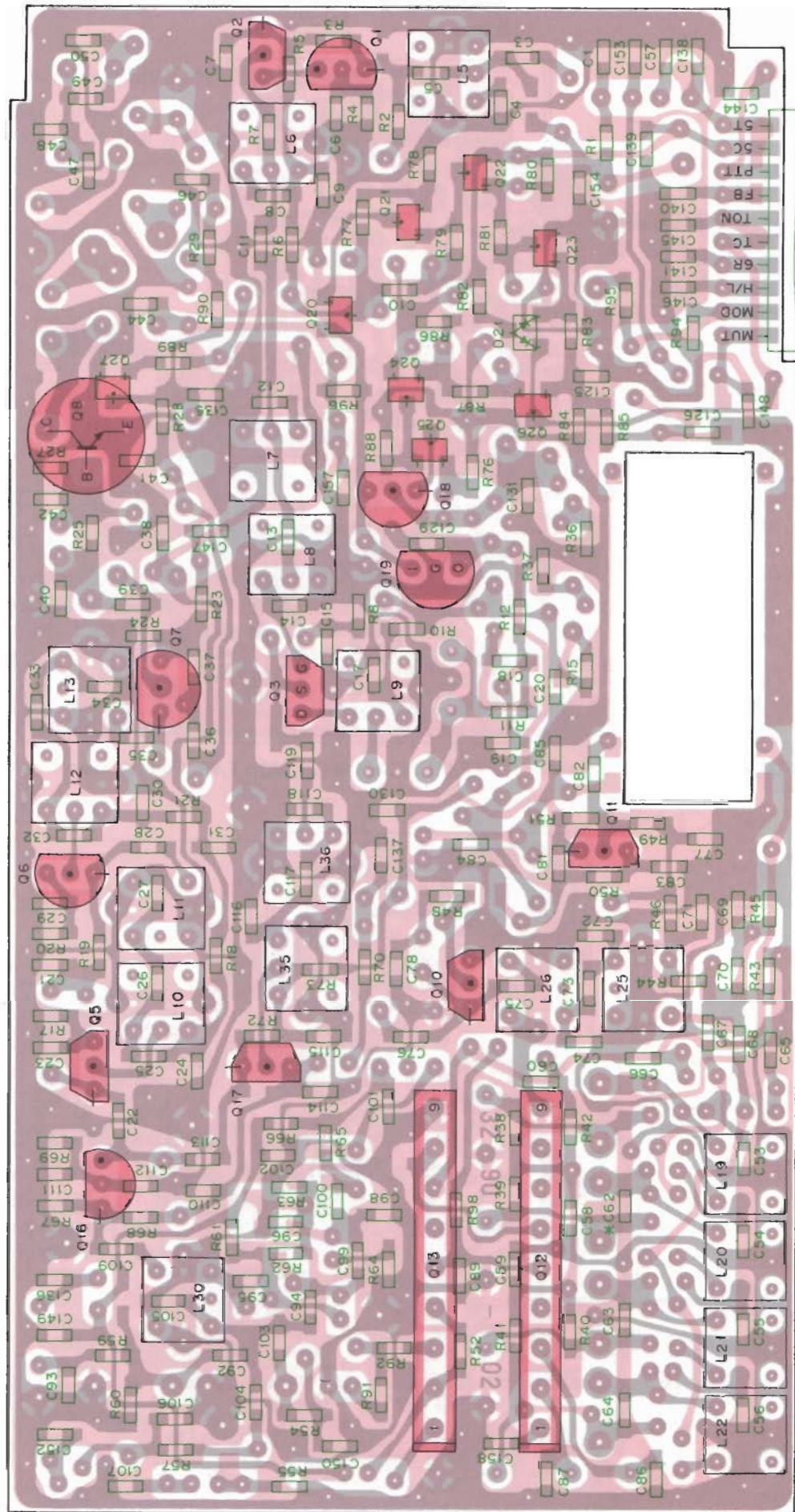
Q1,16 : 2SC2671(H) Q2,5,10,11,17 : 2SC2668(Y) Q3 : 2SK192A(Y) Q4,9,14,15 : 2SC2714(Y) Q6 : 2SC2347 Q7 : 2SC2053 Q8 : 2SC1947 Q12 : TC5082P  
 Q13 : TC5081AP Q18 : 2SB698(E,F) Q19 : LVC517 Q20,26 : 2SA1037K(O) or 2SA1162(Y) Q21,23,25,27 : 2SC2412K(O) or 2SC2712(Y)  
 Q22,24 : 2SA1037K(R) or 2SA1162(G)  
 D2,19,20 : 1SS133 D3,24 : 1S1555 D4 : MI301 D5 : 1S2588 D6-9,15 : MA856 D10,12,13 : BA282 D11 (K1,K2,M1,M2,M3,M4,X) : BA282 D14 : ITT310TE  
 D16 : 1S2208 D17,21 : MA152WA D18,22 (M2,M4,X,T,W) : 1SS133 D23 (T,W) : BA282



	D11	D18,22	D23	JP5	C62
K1,K2,M1,M3	O	X	X	O	O
M2,M4,X	O	O	X	O	O
T,W	X	O	O	X	X

O : Used, X : Not used

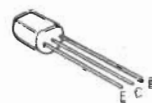
RF UNIT (X44-1630-XX) (-11 : K1,K2,M1,M3 -61 : T,W -71 : M2,M4,X) Foil side view



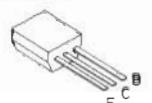
2SC2053



2SB698  
2SC2347



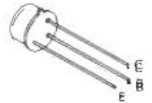
2SC2668



2SC2671



2SC1947



LVC517



2SK192A



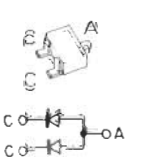
TC5081AP  
TC5082P



2SA1037K  
2SA1162  
2SC2412K  
2SC2712  
2SC2714



MA152WA



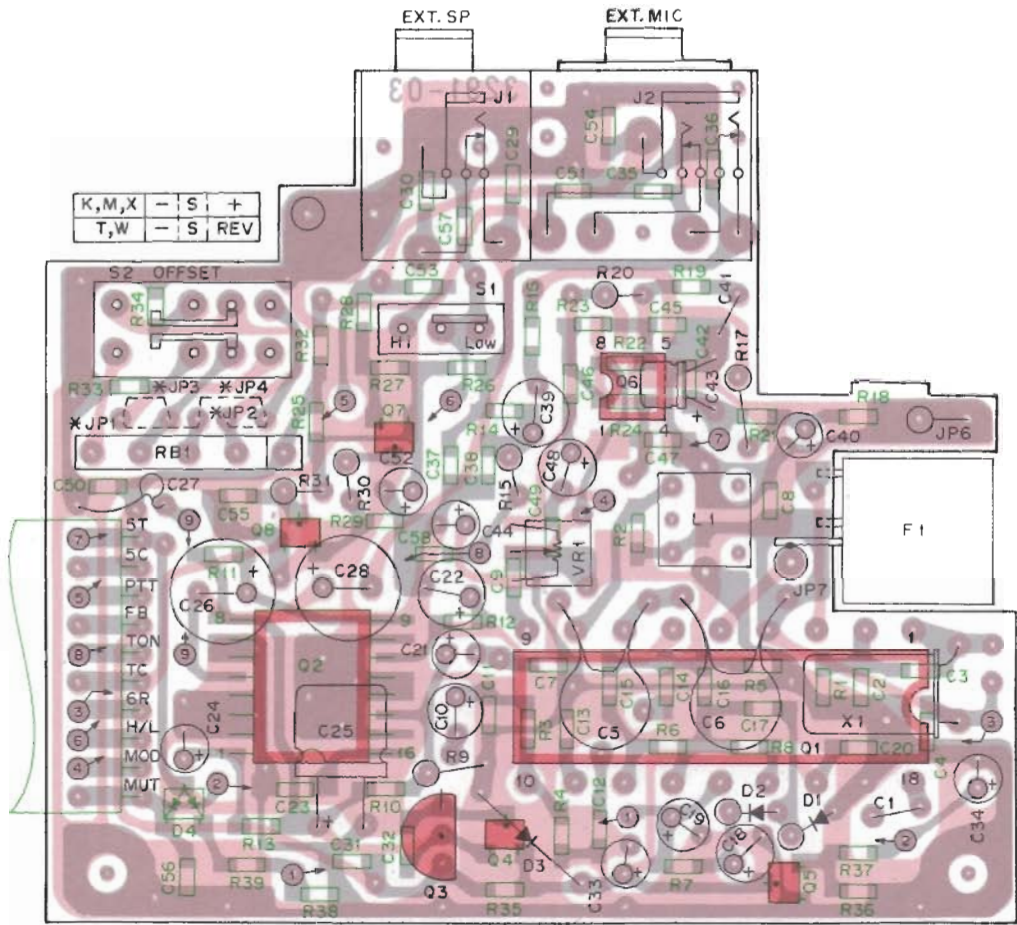
# TH-21A/AT/E PC BOARD VIEWS

IF UNIT (X48-1410-XX) (-11 : K1,K2,M1,M2,M3,M4,X -61 : T,W) Component side view

- Q1 : MC3359P
- Q2 : TA7331F
- Q3 : 2SB698(E,F)
- Q4,5,8 : 2SC2412k(Q) or 2SC2712(Y)
- Q6 : NJM4558M
- Q7 : 2SA1037K(Q) or 2SA1162(Y)
  
- D1,2 : 1N60A
- D3 : MTZ6.8JB
- D4 : MA152WA

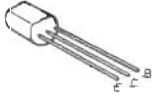
	JP1,2	JP3,4
K,M,X	○	X
T,W	X	○

○ : Used, X : Not used



IF UNIT (X48-1410-XX) (-11 : K1,K2,M1,M2,M3,M4,X -61 : T,W) Foil side view

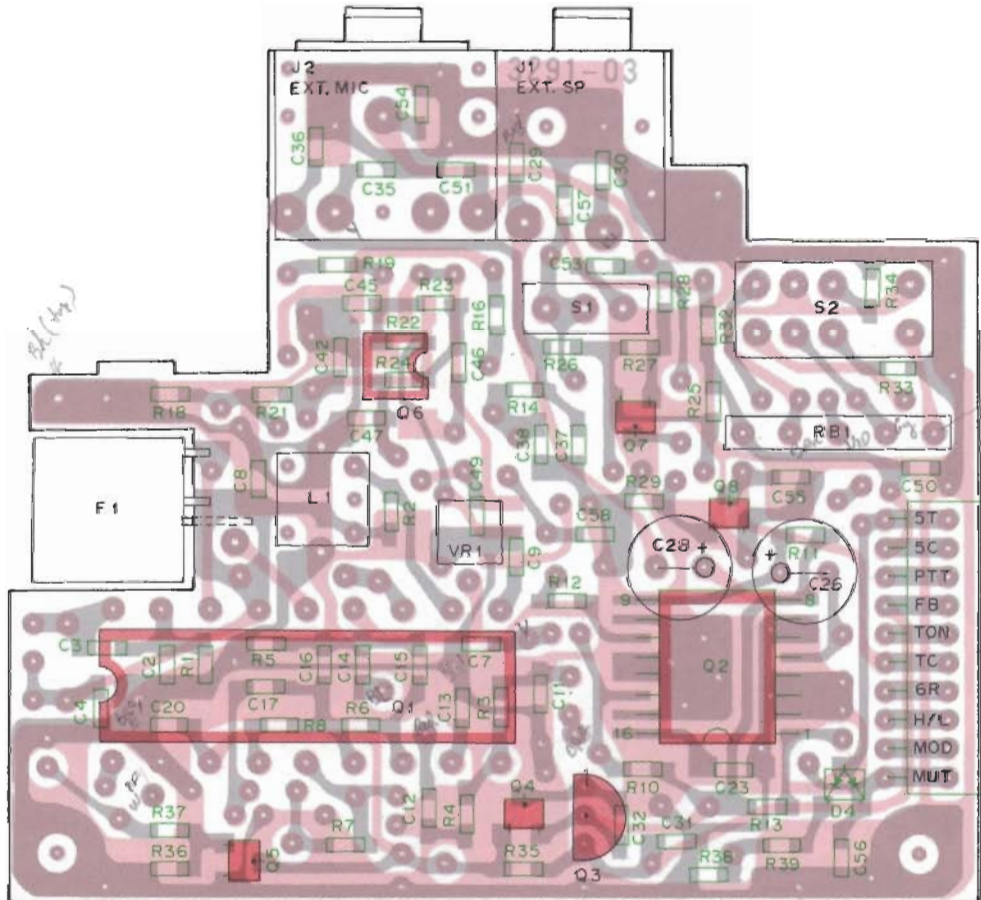
2SB698



2SA1037K  
2SA1162  
2SC2412K  
2SC2712



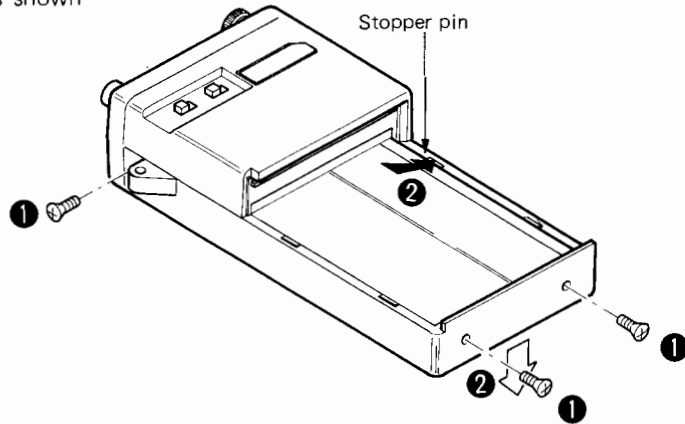
MA152WA



## DISASSEMBLY

### TOP CASE REMOVE METHOD

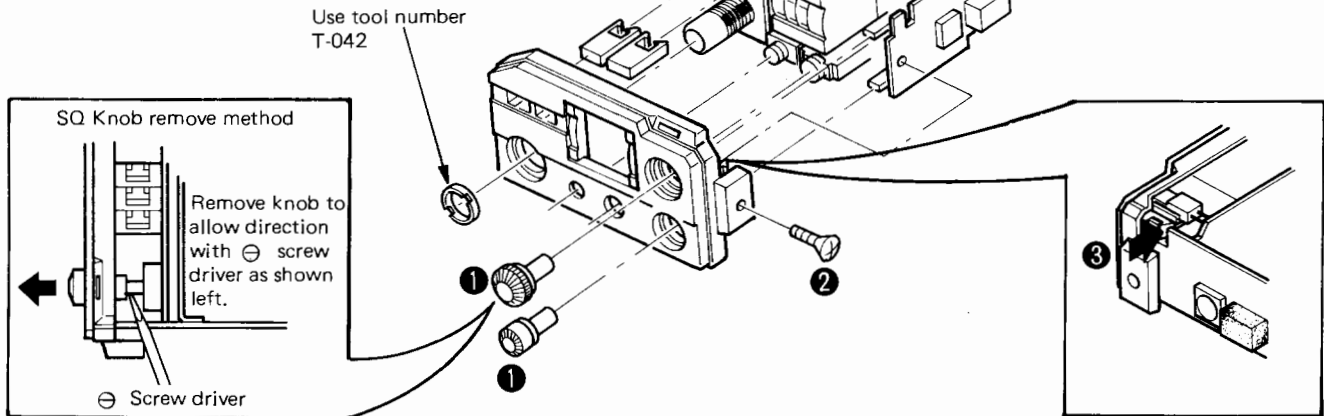
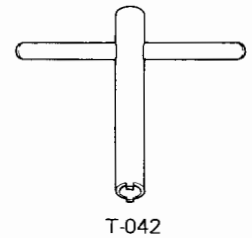
- ① Remove screw (M2 x 5) 3.
- ② Remove front case as allow mark direction holding the stopper pin with something ⊖ screw driver as shown right.



### FRONT PANEL REMOVE METHOD

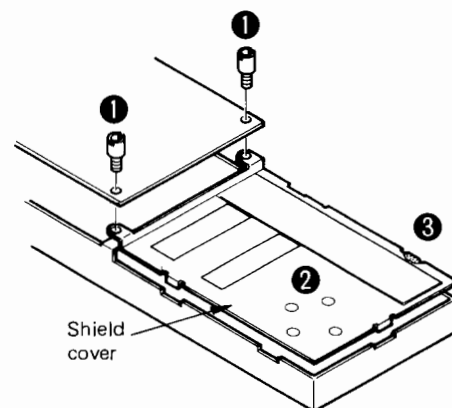
- ① Remove screw on RCA connector and AF, SQ knob.
- ② Remove screw (M2 x 8) 1.
- ③ Remove front panel by push stopper with screw driver as shown below.

### TOOL

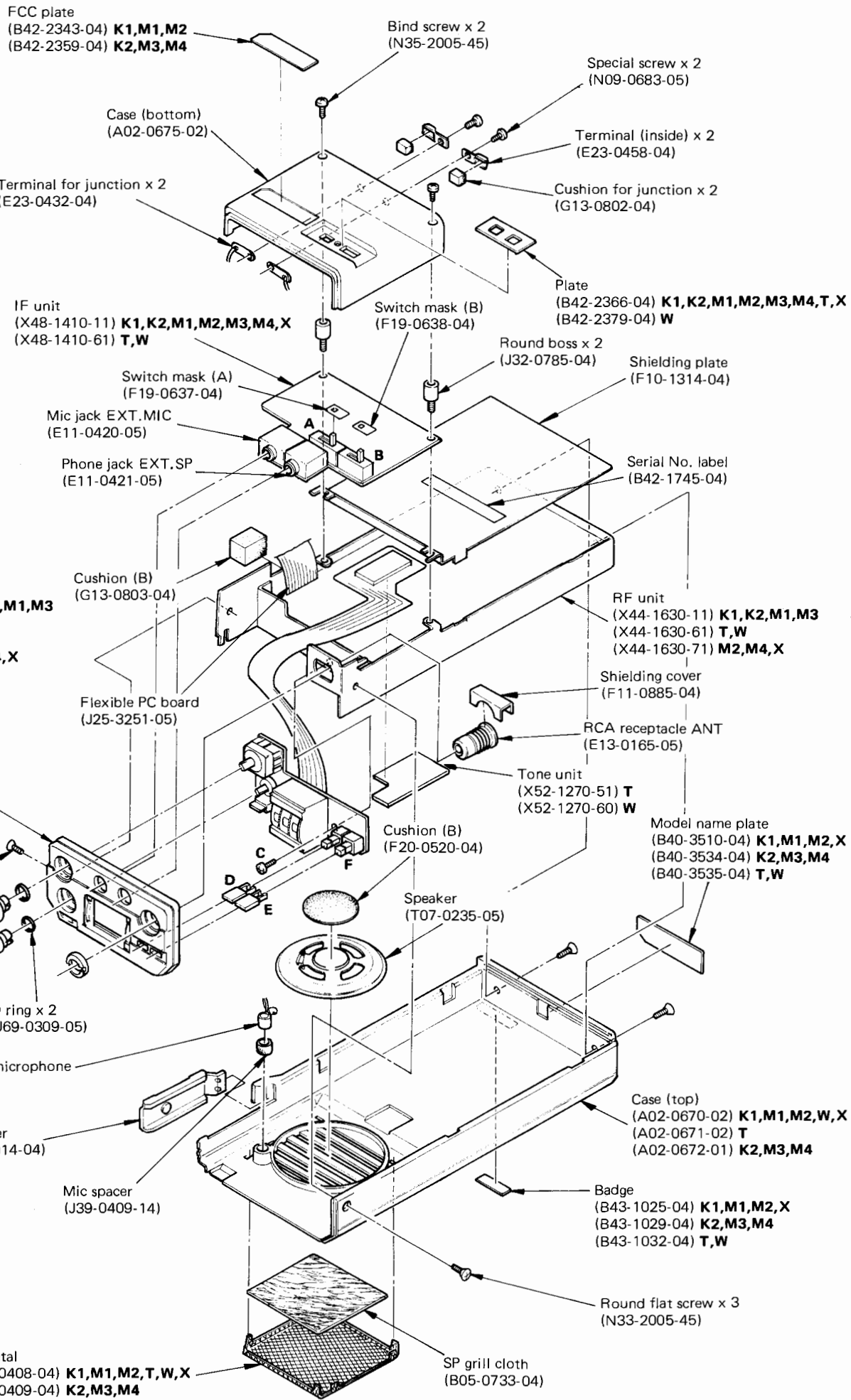


### SHIELD COVER REMOVE METHOD

- ① Remove the top boss which tightened the IF unit.
- ② Remove solder at four spots with solder wick.
- ③ Remove solder heating spot with soldering iron.



# TH-21A/AT/E DISASSEMBLY



2

3

4

5

6

7

- A** Slide switch HI/LOW (S31-1414-05)
- B** Slide switch OFFSET (S31-2409-05)
- C** Pan head screw (N30-2004-41)
- D** Push knob (B) 5K (K27-0469-04)
- E** Push knob (A) TONE (K27-3012-04)
- F** Switch unit (X41-1590-11) **K1, K2, M1, M3**  
(X41-1590-51) **T**  
(X41-1590-61) **W**  
(X41-1590-71) **M2, M4, X**

- Ornamental panel (A21-0768-02)
- Round flat screw (N33-2008-45)
- Knob (A) AF (K29-3012-04)
- Knob (B) SQL (K29-3013-04)
- O ring x 2 (J69-0309-05)

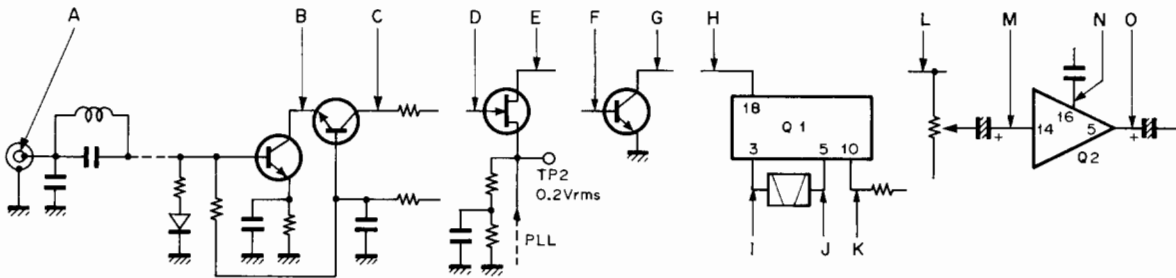
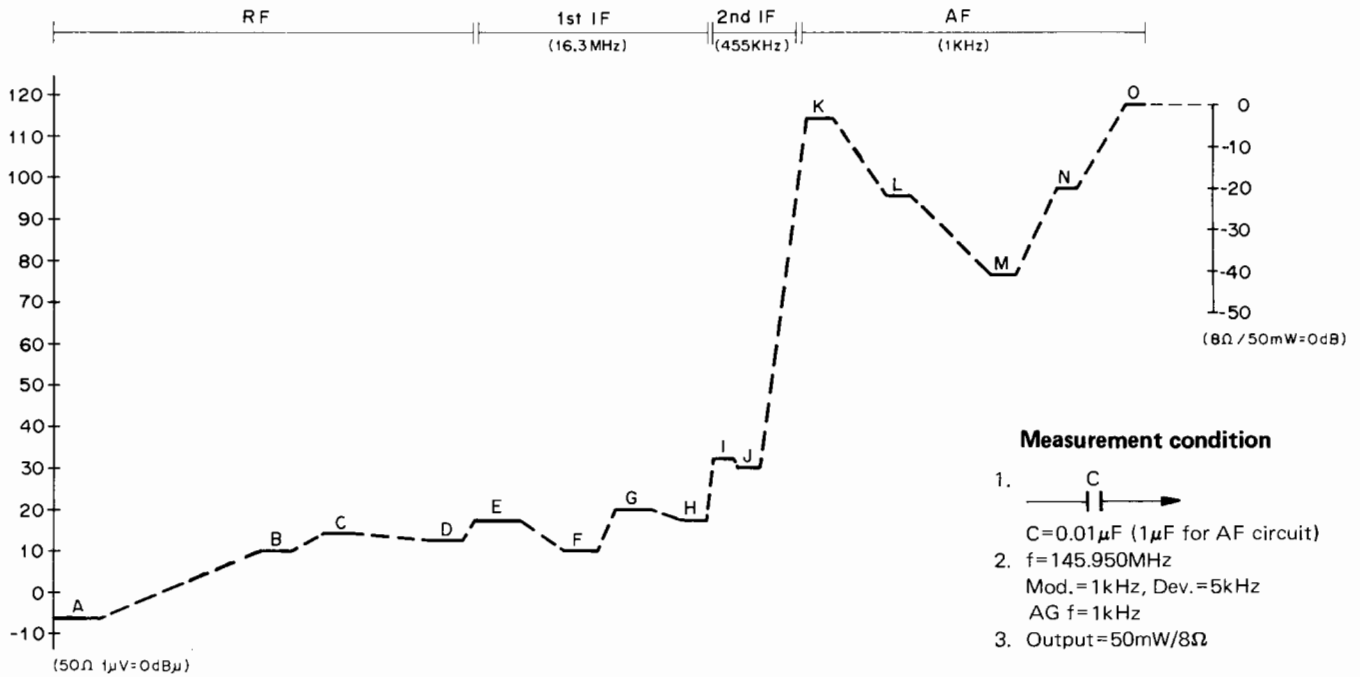
- Electric condenser microphone (T91-0312-15)
- PTT lever (K29-3014-04)
- Mic spacer (J39-0409-14)

- SP metal (B04-0408-04) **K1, M1, M2, T, W, X**  
(B04-0409-04) **K2, M3, M4**

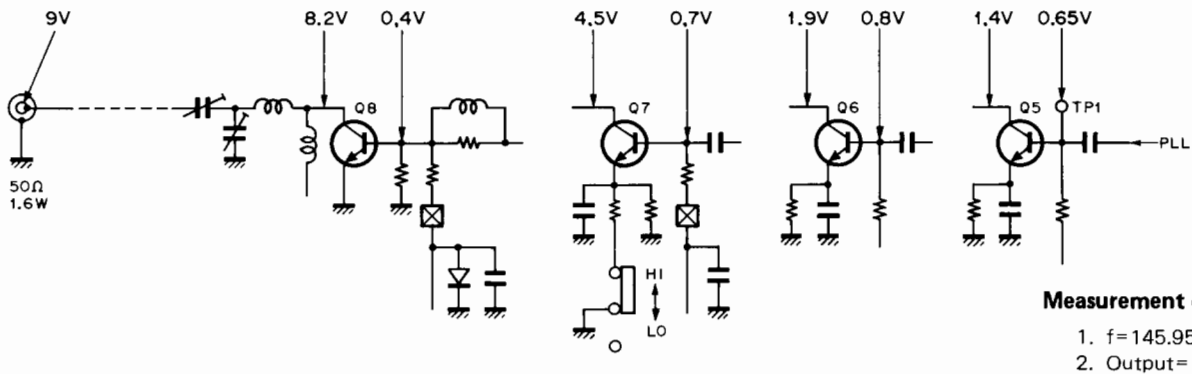


## LEVEL DIAGRAM

### RX SECTION



### TX SECTION



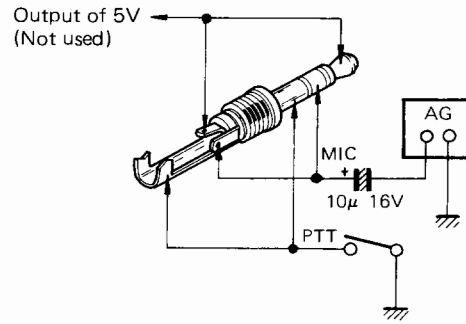
## ADJUSTMENT

### PREOPERATION

Unless otherwise specified. Set the controls as follows.

POWER/VOL ..... OFF  
 HI/LOW ..... HI  
 SQL ..... MIN

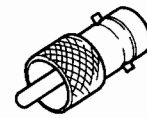
- When adjusting the trimmers or coils, use a non-induced adjusting rod of bakelite, etc.
- When adjusting the RX section never transmit to prevent SSG damage.
- Connect MIC connector as shown right.
- Uses following RCA-BNC adaptor plug (MODEL AJ-3) for ANT connection.
- The output level of SSG is indicated as SSG's open circuit.



MODEL AJ-3

BNC-J


RCA

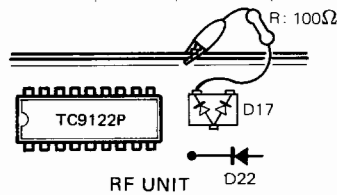


### TX/RX Section (Common)

Item	Condition	Measurement			Adjustment			Specification/ Remarks
		Test-equipment	Unit	Ter-minal	Unit	Part	Method	
1. Voltage check	1) DC power supply : 7.2V	DC V.M	RF	FB				7.2V
	2) 5C			5C				5.0V
	3) 6R			6R				5.7V
	4) 5T PTT : ON			5T				4.9V
	5) Receiver							

### PLL Section

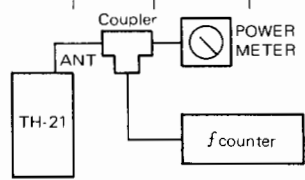
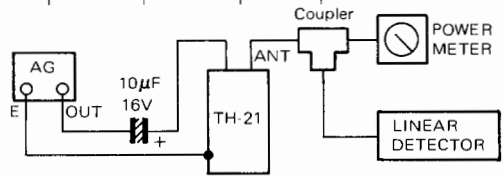
Item	Condition	Measurement			Adjustment			Specifications/ Remarks	
		Test equipment	Unit	Ter-minal	Unit	Part	Method		
1. HET	1) f : any • Cut wire No.1 or connect to GND at Q15 collector on RF unit. • Turn L26 slug all the way inside.  L26  OFFSET switch : "S"	RF VTVM	RF	TP3	RF	L25, 26	MAX Repeat couple times.	Approx. 7mVrms	
	2) Connect D17 (or D22) cathode to GND via 100Ω resistor as shown right. Repeat each on TX/RX.								
2. PLL voltage setting	1) f = 141.00MHz	DC VM	RF	TP4	RF	L30	0.9V	0.9V±0.1V	
	2) f = 144.00MHz, Transmit								Confirm
3. RX. f adjustment	3) Receive								
	1) f = 145.00MHz (T,W) f = 146.00MHz (K,M,X) OFF SET switch : "S"	f.counter	RF	TP2	RF	L19	128.700MHz (T,W) 129.700MHz (K,M,X) (f-16.3MHz)	Within ±100Hz	
	2) 5kHz switch : ON					RF	TC4		128.705MHz (T,W) 129.705MHz (K,M,X)
	3) REV (T,W) only f = 145.00MHz OFF SET switch : REV 5kHz Switch : OFF					RF	L20		128.100MHz
4) 5kHz switch : ON	RF					TC5	128.105MHz		



# ADJUSTMENT

## TX Section

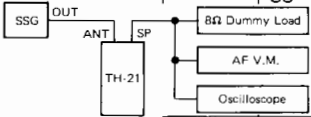
Item	Condition	Measurement			Adjustment			Specifications/ Remarks	
		Test-equipment	Unit	Ter-minal	Unit	Part	Method		
1. Power output adjustment	1) f = 145.00MHz (T,W) f = 146.00MHz (K,M,X) ANT : Connect a power meter HI/LO : HI Transmit Power supply : 7.2V	DC AM			RF	L10-13 TC1	MAX		
		Power meter DC AM (1A)		ANT	RF	TC1-3	MAX	1.2W or more 600mA or less	
	2) f = 144.00MHz HI/LO : HI ----- HI/LO : LO	Power meter					Confirm	1.0W or more 600mA or less	
							Confirm	0.1-0.2W Approx. 300mA	
	3) f = 145.96MHz (T,W) f = 147.96MHz (K,M,X) HI/LO : HI ----- HI/LO : LO	Power meter					Confirm	1.0W or more 600mA or less	
						Confirm	0.1-0.2W Approx. 300mA		
2. Deviation adjustment	1) ANT : Power meter and linear detector, use capacitor 10μF/16V between AG output to MIC terminal f = 145.00MHz (T,W) f = 146.00MHz (K,M,X) AG : 1kHz, 50mV Transmit ----- 2) AG : 1kHz, 5mV	Power meter Linear detector			IF	VR1	4.5kHz	4.5kHz±0.1kHz	
									Confirm
3. Tone encoder (K2,M3,M4) Type only	1) Push the "3" and "6" key.	Linear detector f. counter			DTMF	VR1	3.0kHz	Within ±0.5kHz	
			DTMF	TON			Confirm. freq.	1471.9Hz±5Hz	
	2) Push the "2" and "3" key.						Confirm. DEV	1.2kHz±0.5kHz	
4. Tone (T,W) type only	1) (T) type only : Shorted C7 (Tone unit) Transmit Tone switch : ON		TONE	TON	TONE	VR1	1750Hz	Within ±17.5Hz	
							Confirm. DEV	2.5kHz or more	
5. Option tone unit (TU-6) used (K,M,X)	1) Transmit Tone switch : ON				(TU-6)	VR1	0.5kHz	0.5-0.6kHz	
6. TX f adjustment	1) f = 145.00MHz (T,W) f = 146.00MHz (K,M,X) OFF SET switch : "S" Transmit ----- 2) 5kHz switch : ON	Power meter f. counter			RF	L21	145.00MHz (T,W) 146.00MHz (K,M,X)	Within ±100Hz	
							TC6		145.005MHz (T,W) 146.005MHz (K,M,X)
	3) f = 145.00MHz (T,W) f = 146.00MHz (K,M,X) OFF SET switch : "-" Transmit ----- 4) 5kHz Switch : ON						L22		144.400MHz (T,W) 145.400MHz (K,M,X)
							TC7		144.405MHz (T,W) 145.405MHz (K,M,X)
	5) (K,M,X) type only f = 146.00MHz OFF SET switch : "+" Transmit ----- 6) 5kHz switch : ON						L20		146.600MHz
							TC5		146.605MHz



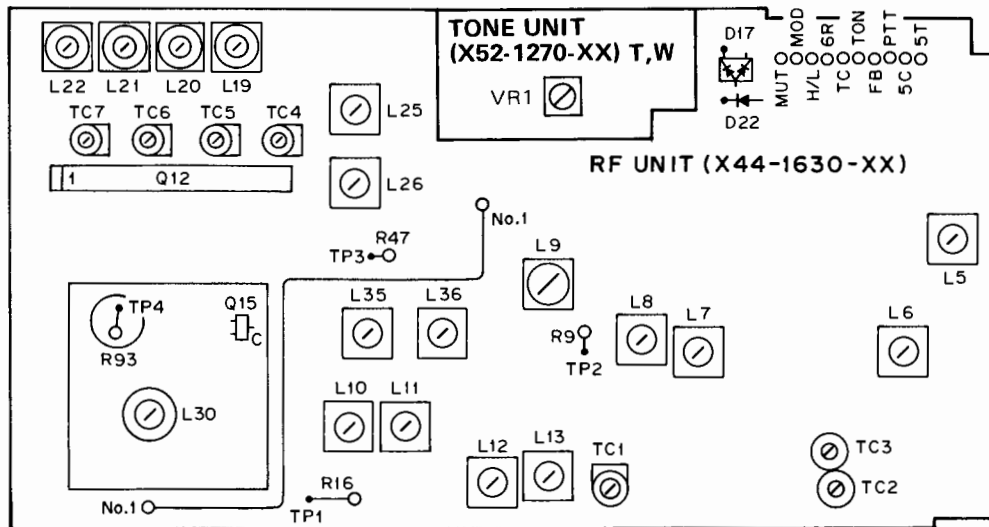
## ADJUSTMENT

### RX Section

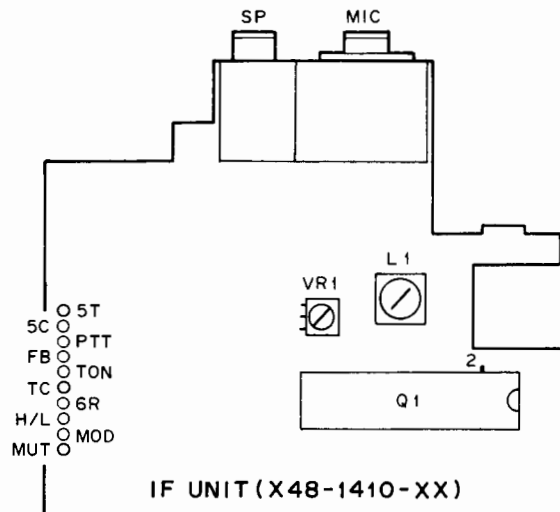
Item	Condition	Measurement			Adjustment			Specifications/ Remarks	
		Test-equipment	Unit	Terminal	Unit	Part	Method		
1. Sensitivity	1) f : any	f.counter	IF	Q1- 2			Confirm	15.845MHz±240Hz	
	2) SSG : 145.04MHz (T,W) 146.04MHz (K,M,X) -4~-6dBμ MOD: 1kHz DEV, 5kHz	SSG AF V.M Oscillo- scope 8Ω Dummy load		EXT.SP	RF	L5-8 L9,35, 36	MAX		
	SSG : 0dBμ				IF	L1	MAX		
S/N	3) f = 144.00-147.99MHz (K,M,X) f = 144.00-145.99MHz (T,W)						Confirm	S/N 28dB or more	



### TOP VIEW

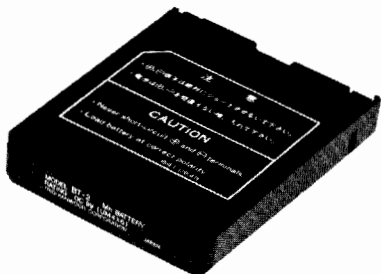


### BOTTOM VIEW

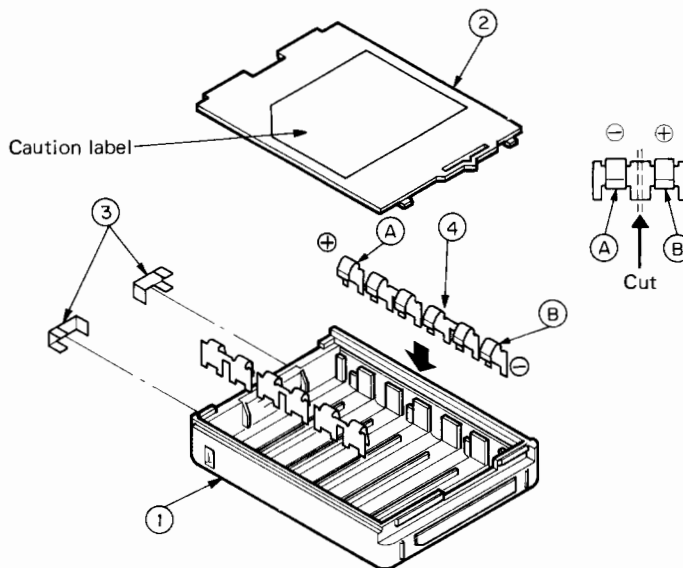


## BT-2 (AAA MANGANESE/ALKALINE BATTERY CASE)/ EB-2 (EXTERNAL C MANGANESE/ALKALINE BATTERY CASE)/ PB-21 (Ni-Cd BATTERY)

### BT-2 OUTSIDE VIEW



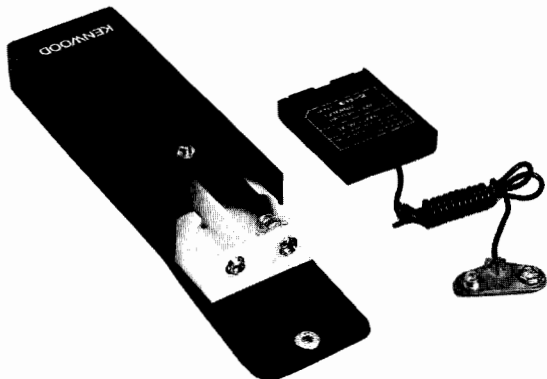
### BT-2 DISASSEMBLY



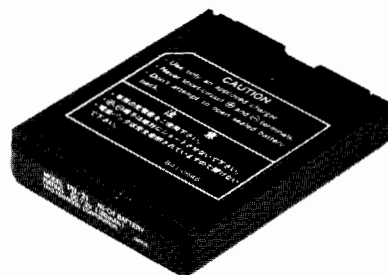
### BT-2 PARTS LIST

Parts No.	Re- marks	Description	Ref. No.
A02-0677-02	*	Battery case	1
A02-0678-03	*	Battery case cover	2
E23-0451-04		Terminal board (A) x 2	3
E23-0452-04		Terminal board (B) x 6	4

### EB-2 OUTSIDE VIEW



### PB-21 OUTSIDE VIEW



### EB-2 PARTS LIST

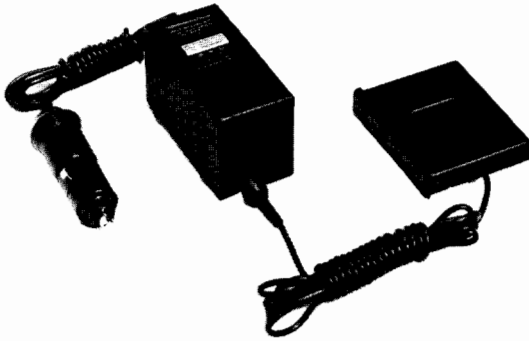
Parts No.	Re- marks	Description	Ref. No.
A02-0677-02	*	Battery case	
A02-0678-03	*	Battery case cover	
E23-0451-04		Terminal board (A) x 2	
E30-1793-05	N*	Cord ass'y	
H25-0103-04		Protective bag (Hard case)	
H25-0096-04		Protective bag (Battery case)	
J21-4154-04	N*	Fied plate (Cord bushing)	

### PB-21 SPECIFICATIONS

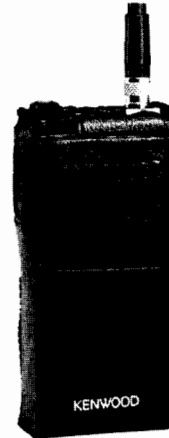
Output voltage . . . . . 7.2V  
 Charging current . . . . . 36mA (ordinary charging for approx. 8hrs.)  
 Charging current . . . . . 180mAH  
 Dimensions . . . . . 57 (W) x 71 (H) x 14 (D) mm  
 Weight . . . . . Approx. 80g

## DC-21 (DC-DC CONVERTER)/SC-8/8T (SOFT CASE)

DC-21 OUTSIDE VIEW



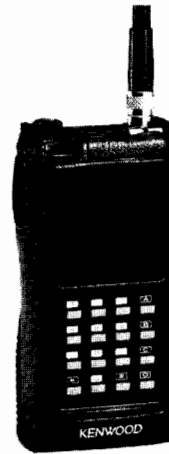
SC-8 OUTSIDE VIEW



**DC-21 SPECIFICATIONS**

Input voltage . . . . . 13.8V DC (12–16V)  
 Output voltage . . . . . 8V DC ±5%  
 Output current . . . . . 900mA (at input voltage of 13.8V  
 DC with max. load)  
 Weight . . . . . Approx. 260g

SC-8T OUTSIDE VIEW



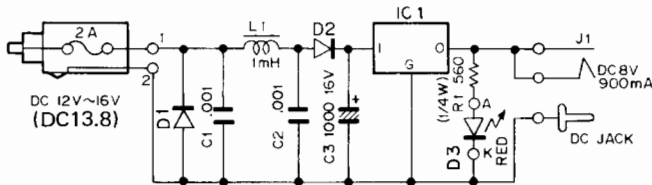
**DC-21 PARTS LIST**

Parts No.	Re- marks	Description	Ref. No.
A02-0677-02	*	Battery case	
A02-0678-03	*	Battery case cover	
E03-0203-05		DC jack	J1
E23-0451-04		Terminal board (A) x 2	
E30-1791-05	N	Cord with plug	
E30-1796-05		Cord with cigarette plug and fuse	
F05-2023-05		Fuse 2A	
J42-0439-05		Cord bushing	
L15-0305-05		Choke coil 1mH	L1
NJM7808A		IC	IC1
SLH-34-VC3		LED (Red)	D3
U05B		Diode	D1
V06C		Diode	D2

**SC-8/8T PARTS LIST**

Parts No.	Re- marks	Description	Ref. No.
J19-1408-04	N	Belt hook	

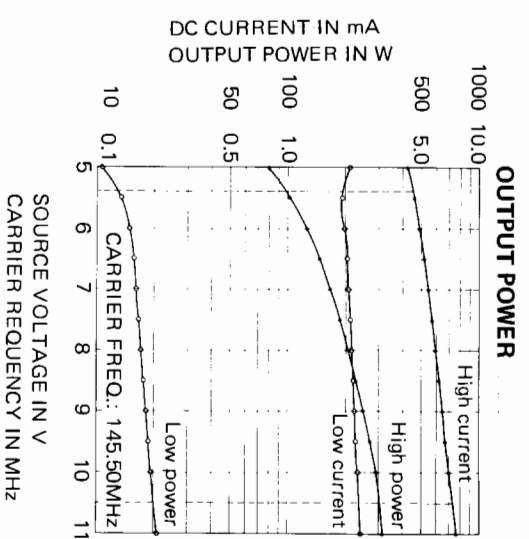
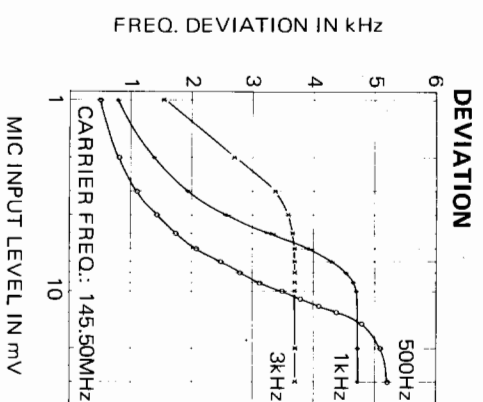
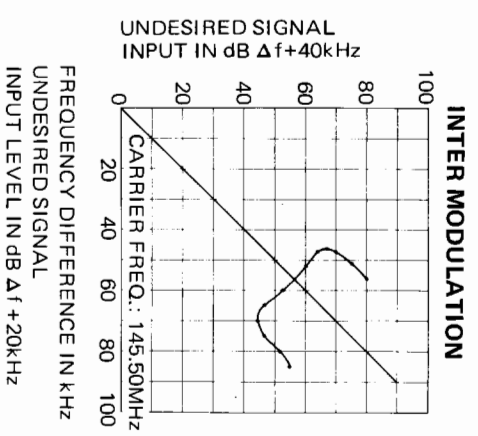
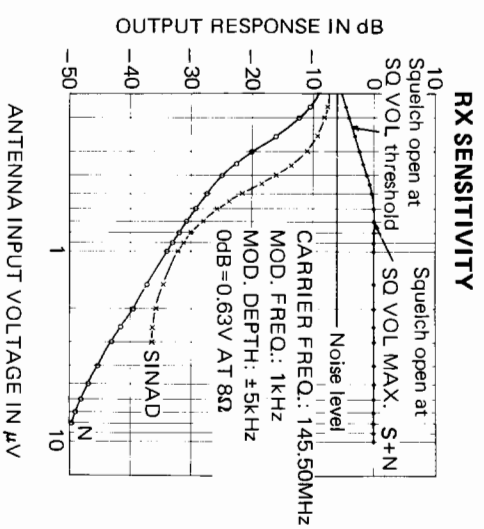
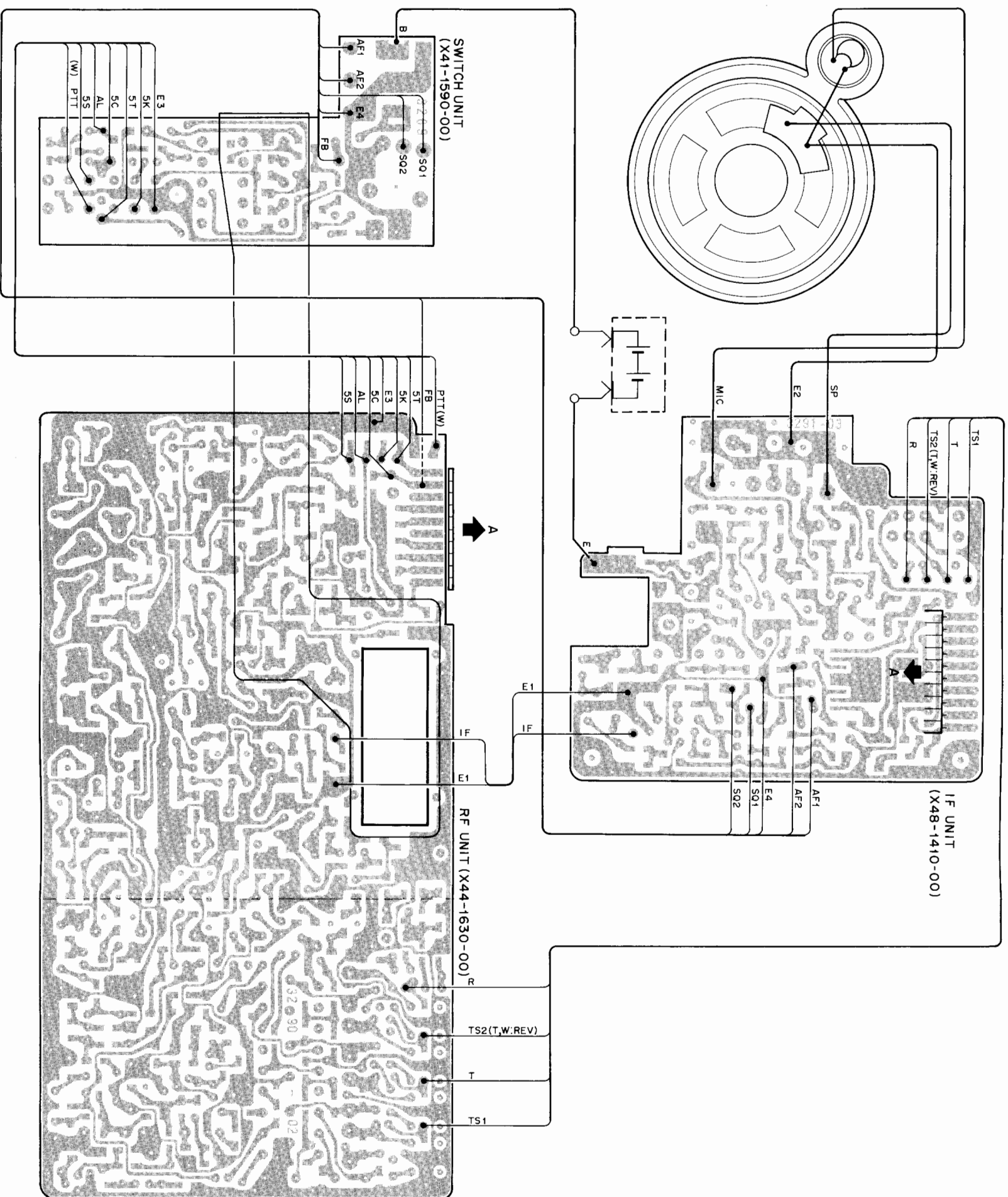
**DC-21 SCHEMATIC DIAGRAM**



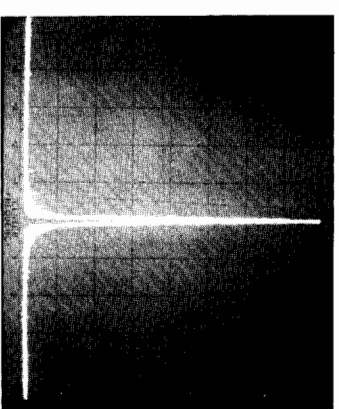
IC1 : NJM7808A      D1 : U05B  
 D2 : V06B  
 D3 : SLH34-VC3



WIRING/REFERENCE DATA

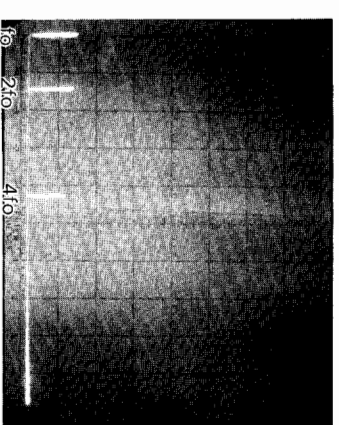


NEAR SPURIOUS RESPONSE



CARRIER FREQ.: 145.50MHz  
 RF POWER: 1.6W  
 SCAN WIDTH: 2MHz/DIV  
 BAND WIDTH: 30kHz  
 SCAN TIME: 0.1 SEC  
 VIDEO FILTER: 10kHz  
 INPUT ATT: 0dB  
 LOG REF LEVEL: -10dBm  
 10dB/DIV

HARMONICS SPURIOUS RESPONSE



CARRIER FREQ.: 145.50MHz  
 RF POWER: 1.6W  
 SCAN WIDTH: 100MHz/DIV  
 BAND WIDTH: 30kHz  
 SCAN TIME: 2 SEC  
 VIDEO FILTER: 10kHz  
 INPUT ATT: 0dB  
 LOG REF LEVEL: -10dBm  
 10dB/DIV

The fundamental signal is reduced by HPF.  
 (fc : 240MHz)

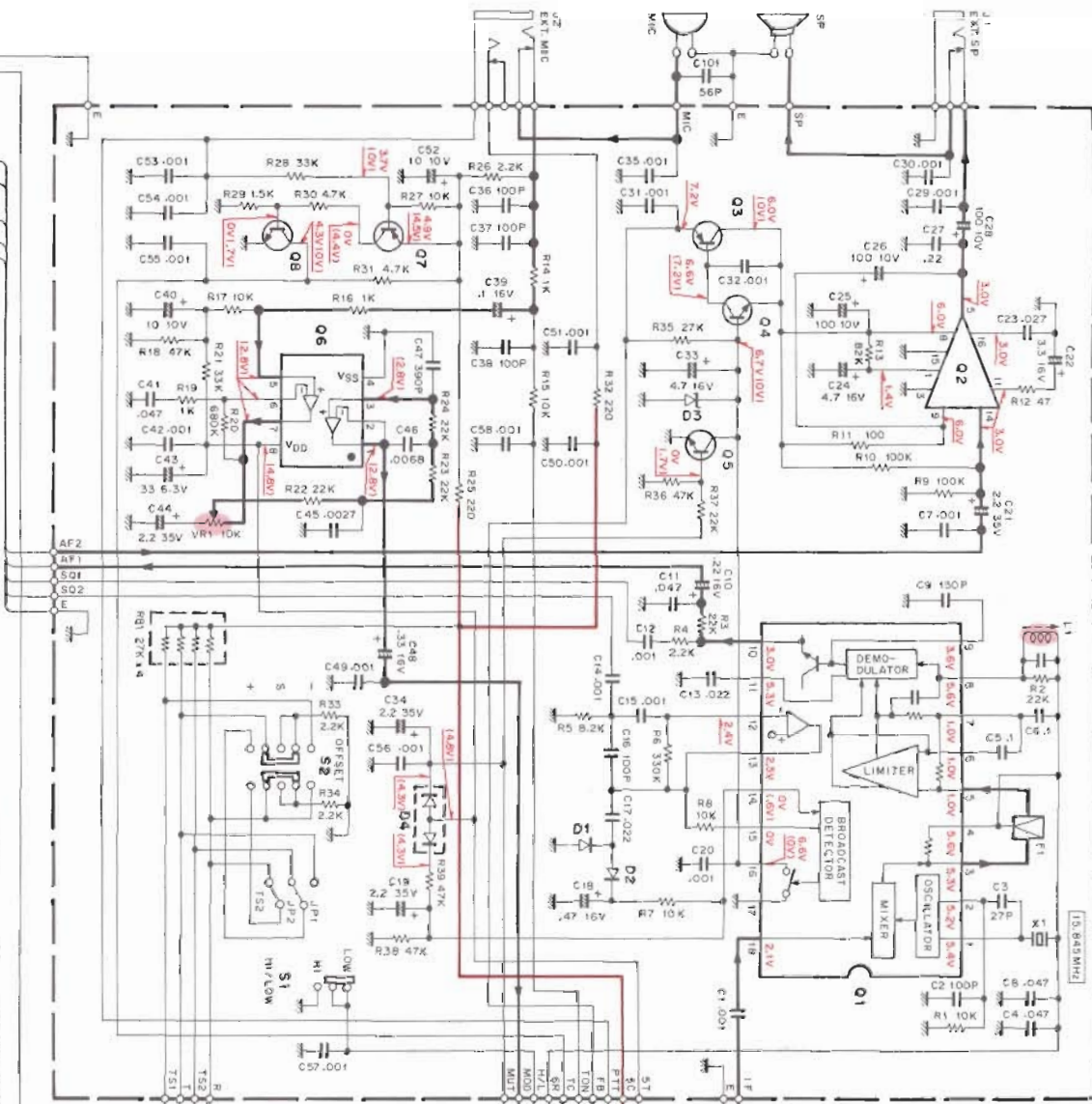


Signal line — Control line — Common DC line

Voltage measurement conditions f = 145.50MHz, RX no signal ( ) : TX.

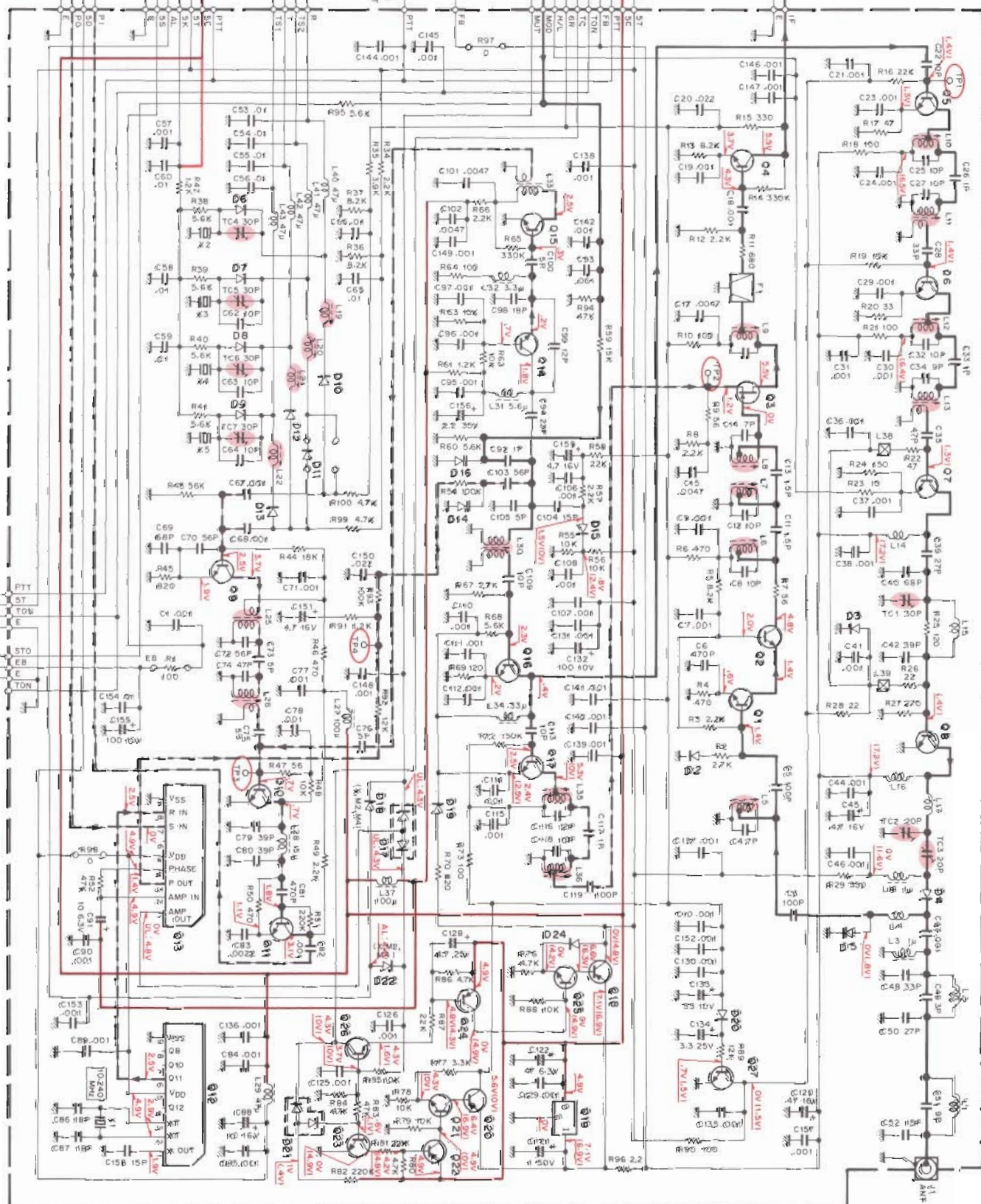
# TH-21A/AT SCHEMATIC DIAGRAM

RF UNIT (X48-1410-11)



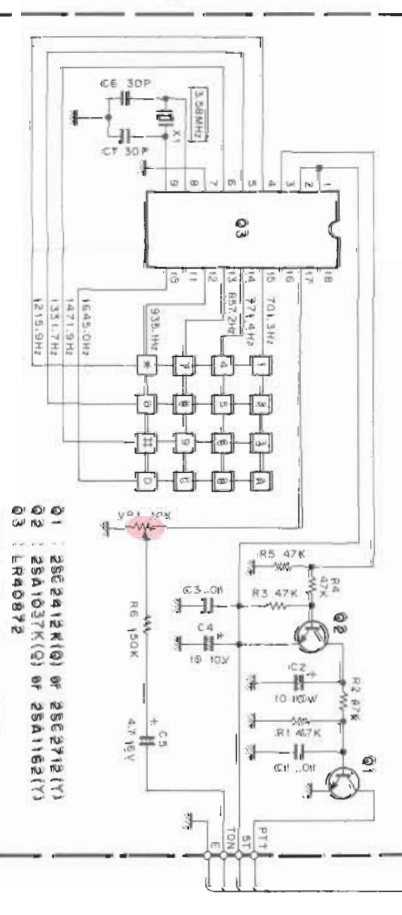
- 01 : MC3350P
- 02 : TA7331F
- 03 : 2SB681E,F
- 04,5,8 : 2SC2412K(I) or D1,2 : IN60A
- 05 : 2SC2412K(I) or D3 : MTZ6,8
- 06 : NJM4558M
- 07 : 2SA1037K(I) or 2SA1162(I)

RF UNIT (X44-1630-XX) (-11: K1, K2, M1, M3 -71: X, M2, M4)



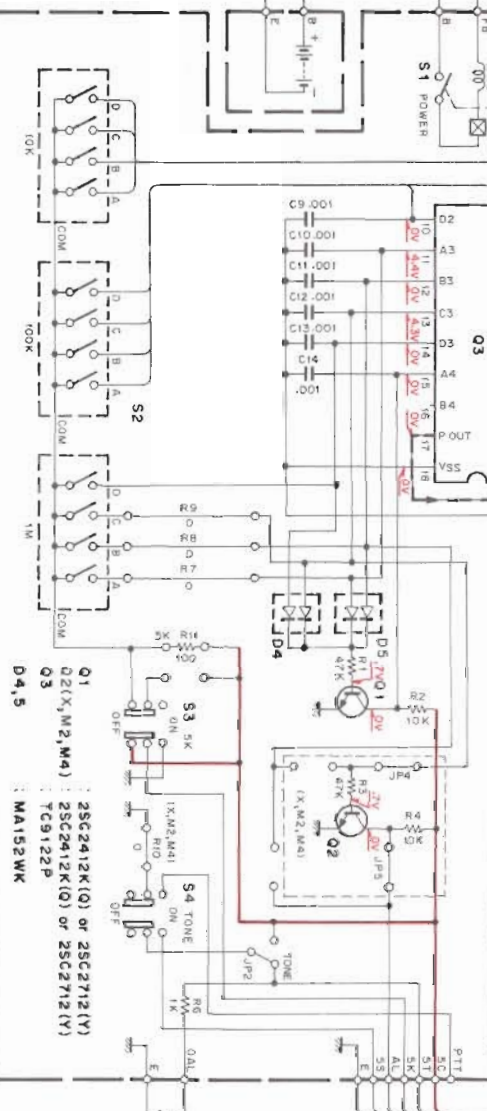
- 01,16 : 2SC2671(H)
- 02,5,10,11,17 : 2SC2668(I)
- 03 : 2SK192A(I)
- 04,9,14,15 : 2SC2714(I)
- 06 : 2SC2347
- 07 : 2SC2053
- 08 : 2SC1947
- 09 : 2SC1082P
- 010 : TC5081AP
- 011 : 2SB681E,F
- 012 : LVCS17
- 013 : 2SA1037K(I) or 2SA1162(I)
- 014 : 2SA1037K(I) or 2SA1162(I)
- 015 : 2SC2412K(I) or 2SC2712(I)
- 016,17,21 : 2SC2671(H)
- 018,22 : 2SK192A(I)
- 019 : 2SA1162(I)
- 020,26 : BA292
- 021,23,25,27 : 2SA1037K(I) or 2SA1162(I)
- 022,24 : 2SA1037K(I) or 2SA1162(I)

DTMF UNIT (TH-21AT ONLY)

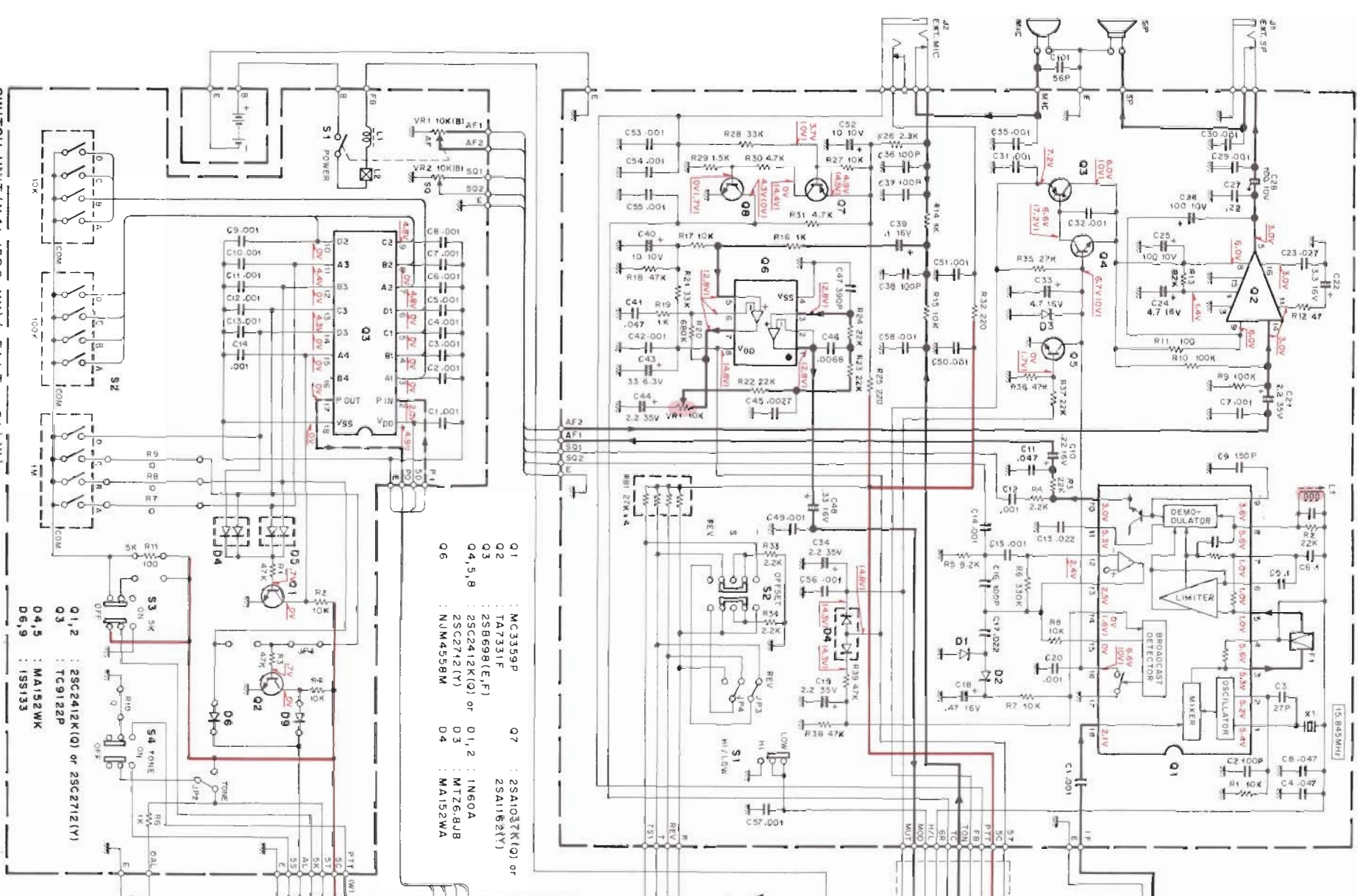


- 01 : 2SC2412K(I) or 2SC2712(I)
  - 02 : 2SA1037K(I) or 2SA1162(I)
  - 03 : RA40872
- TONE UNIT  
TU-6 (OPTION)
- 01,16 : 2SC2671(H)
  - 02,5,10,11,17 : 2SC2668(I)
  - 03 : 2SK192A(I)
  - 04,9,14,15 : 2SC2714(I)
  - 06 : 2SC2347
  - 07 : 2SC2053
  - 08 : 2SC1947
  - 09 : 2SC1082P
  - 010 : TC5081AP
  - 011 : 2SB681E,F
  - 012 : LVCS17
  - 013 : 2SA1037K(I) or 2SA1162(I)
  - 014 : 2SA1037K(I) or 2SA1162(I)
  - 015 : 2SC2412K(I) or 2SC2712(I)
  - 016,17,21 : 2SC2671(H)
  - 018,22 : 2SK192A(I)
  - 019 : 2SA1162(I)
  - 020,26 : BA292
  - 021,23,25,27 : 2SA1037K(I) or 2SA1162(I)
  - 022,24 : 2SA1037K(I) or 2SA1162(I)

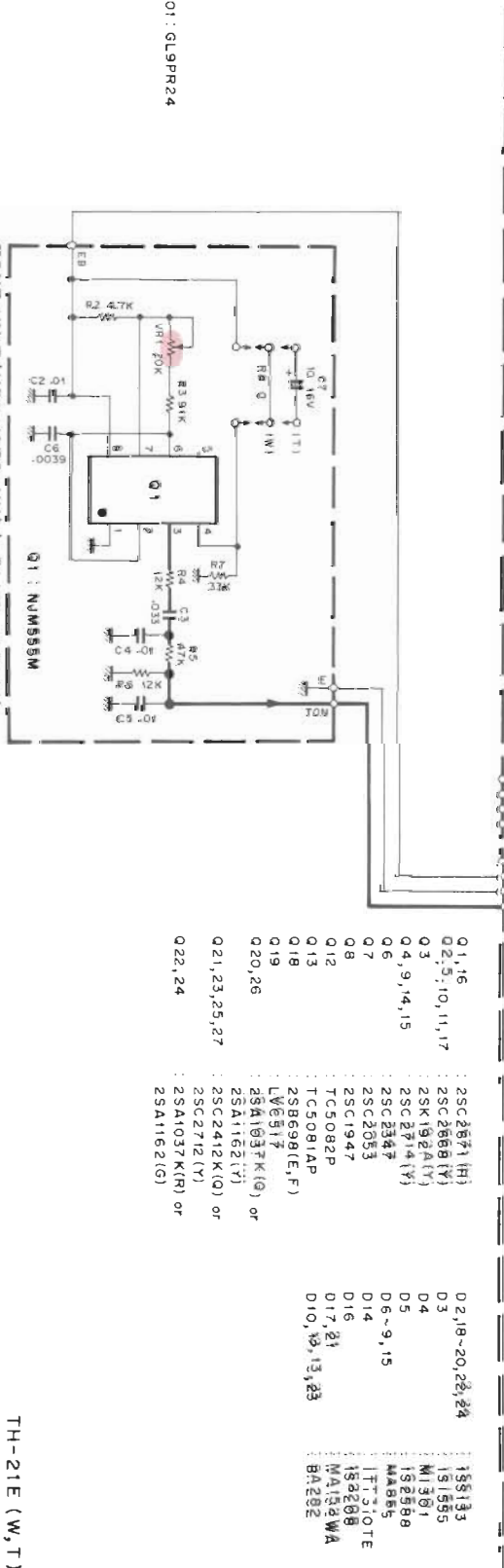
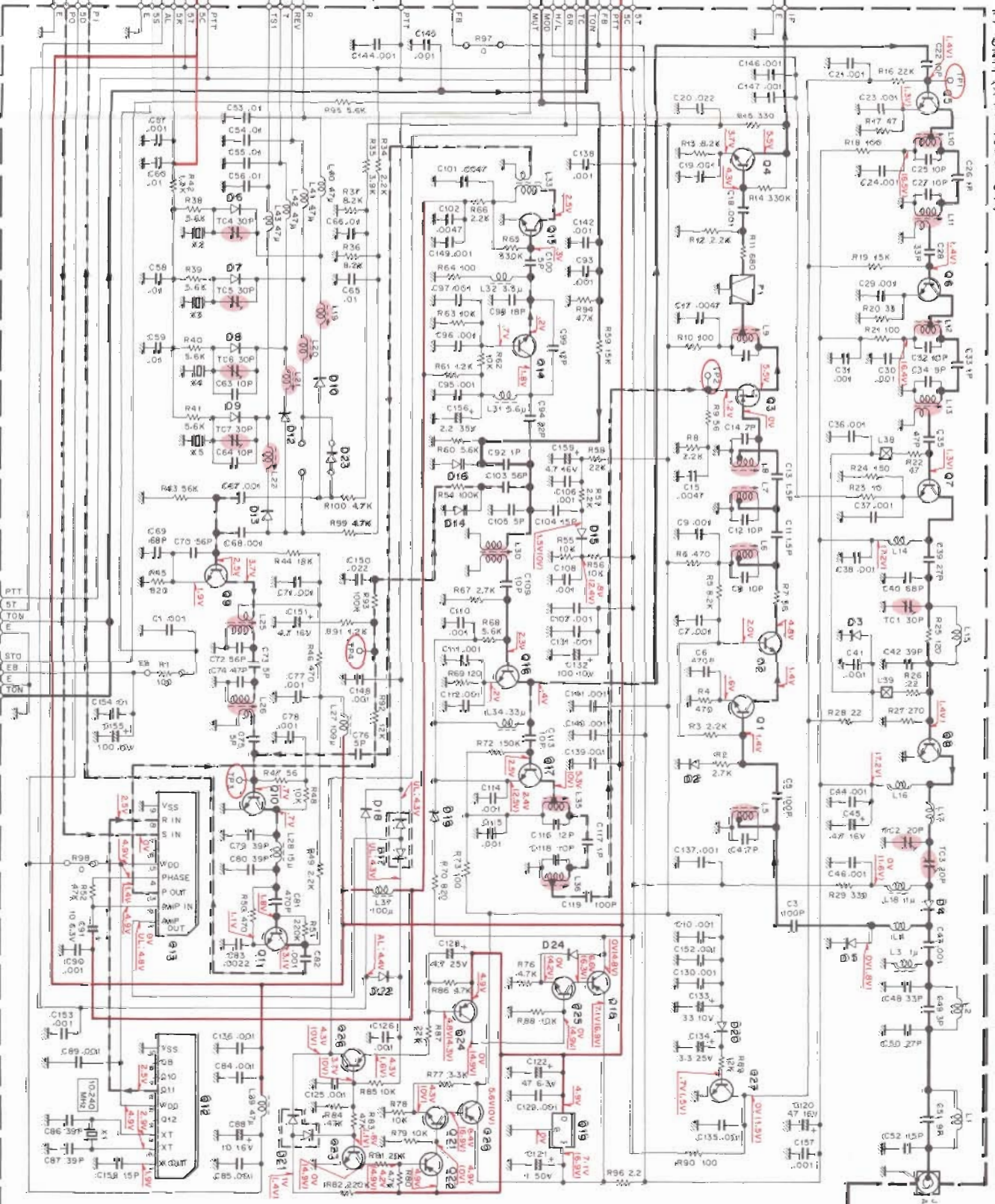
SWITCH UNIT (X41-1990-XX) (-11: K1, K2, M1, M3 -71: X, M2, M4)



1F UNIT (X48-1410-61)



2F UNIT (X44-1630-61)



Signal line — Control line — Common DC line Voltage measurement conditions, f=145.50MHz, RX no signal, I<sub>0</sub> 1X.

- Q1 : MC3359P
- Q2 : 1A7331F
- Q3 : 2SB6981E(F)
- Q4,5,8 : 2SC2412K(O) or 01,2 : 1N60A
- Q6 : 2SC272(Y)
- Q7 : M726,8,9
- Q8 : NUM455BM
- Q9 : MA152WA

- Q1,16 : 2SC2671(H)
- Q2,5,10,11,17 : 2SC2668(Y)
- Q3 : 2SK192A(Y)
- Q4,9,14,15 : 2SC2714(Y)
- Q6 : 2SC2347
- Q7 : 2SC2053
- Q8 : 2SC1947
- Q12 : TC5082P
- Q13 : TC5081P
- Q18 : 2SB6981E(F)
- Q19 : WE517
- Q20,26 : 2SA1037K(O) or 2SA1162(Y)
- Q21,23,25,27 : 2SC2712(Y)
- Q22,24 : 2SA1037K(O) or 2SA1162(O)
- Q2 : 1S8133
- Q3 : 1S7585
- Q4 : M1301
- Q5 : 1S6586
- Q6-9,15 : MA685
- Q10 : 1T-310TE
- Q14 : 1S2088
- Q16 : MA152WA
- Q17,21 : BA282
- Q10,13,13,23



**SPECIFICATIONS****General**

Frequency range	144 – 146MHz ; TH-21E, TH-21A (Ociaia version only) 144 – 148MHz ; TH-21A/AT
Signal type	F3 (FM)
Operating temperature	-20°C ~ +50°C
Antenna impedance	50Ω
Power supply voltage	5.8V – 10.0V (rating voltage ; 7.2V)
Power consumption	At reception standby ; Less than 28mA At transmission (Hi) ; Less than 600mA (Low) ; About 300mA
Dimensions	57 (65.5) W x 120 (127.5) H x 28 (32) D mm The numbers in the parenthesis include projections parts.
Weight	Approx. 290g (including antenna and Ni-Cd batteries)

**Transmitter section**

Output power	Hi ; 1.0W, Low ; approx. 150mW
Modulation system	Reactance modulation
Max. frequency deviation	±5kHz
Unwanted reflection	Less than -60dB
Microphone	Condenser type

**Receiver section**

Reception system	Double superheterodyne
Intermediate frequency	1st ; 16.3MHz, 2nd ; 455kHz
Sensitivity	S/N more than 28dB at -6dBμ (0.5μV) input 12dB SINAD ; less than -12dBμ (0.25μV)
Squelch sensitivity	Less than 0.25μV
Selectivity	-6dB at more than 12kHz -40 dB at less than 28kHz
AF output	More than 250mW (8Ω load, distortion 10%)

Design and specifications subject to change without notice.

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