

KENWOOD

SERVICE MANUAL

AT-250

AUTOMATIC ANTENNA TUNER



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A block diagram of the AT-250 is shown in Fig. 1. The AT-250 covers all HAM bands from 1.8MHz to 29MHz. When the TUNER and TUNE switches are turned ON and the companion TS-430 transceiver is placed in the transmit mode, both forward and reflected power are detected by directional coupler L201 and L202, which appears between the Control unit (B) (X53-1360-00) IN and OUT terminals. Forward and reflected power is also detected by directional coupler L101 and L102, located between the Control unit (A) ANI and ANT terminals. The former coupler is used to drive the SWR meter and the RF power meter (20W and 200W). The directional couplers are toroidal core transformers; these provide superior characteristics within the 1.8 to 30MHz HF range.

The forward power voltage signal detected by L101 is applied to IC101 pin 9 and the reflected power current signal is applied to IC101 pin 13. Both signals are waveformed by IC101 and phase-compared by IC102. IC102 has a built-in D-type master slave flip-flop whose output level changes from H to L (or L to H) when the voltage phase leads (or lags) that of the current phase. The outputs from IC102 are applied to buffer amp IC103 pins 10 and 15, so the output levels at IC103 pins 12 and 13 change between L and H depending upon the relationship between the voltage and current phases. These signals are applied to the motor drive circuits consisting of Q116 to Q121 via an emitter coupled logic circuit consisting of Q108 and Q109. Then, motor M1 rotates variable capacitor VC1 in the forward or reverse direction.

On the other hand, the signals detected by L101 are also applied to voltage comparator IC104 pins 4 and 6. When the voltage at pin 6 is higher than that at pin 4, a H level signal is output from pin 1 and a L level signal is output from pin 2; the opposite is the case when the voltage at pin 6 is lower than that at pin 4.

VC1 and VC2 are independently driven; however the phase and voltage are mutually dependent so VC1 and VC2 operate interdependently. When the voltage at IC104 pin 4 becomes equal to that at pin 6, the output levels at both pins 1 and 2 go L because a voltage lower than the input voltage at pins 4 and 6 is applied to both pins 5 and 7. Therefore, the motor drive circuits are turned off and the motors stop.

Voltages detected by L201 and L202 and corresponding to forward and reflected power are V-I converted in the SWR calculation circuit IC204. The resulting SWR signal is sent to Control unit (A) via the ISW terminal. This signal is applied to IC105 pin 2, where it is subjected to I-V conversion. The resulting SWR voltage signal is output from pin 1. As described previously, the AT-250 is designed so that VC1 and VC2 stop when the SWR drops below 1.2. The principle of this operation will now be explained. The voltage applied to IC104 pin 8 (the inverted input) is set

to the same level by VR102 as the output voltage of IC105 (from pin 1) when the SWR is 1.2. Therefore, the output voltage at IC104 pin 14 is H when the SWR is greater than 1.2 and DC power is supplied to the motor drive circuits. When the SWR is 1.2 or less, the level at IC104 pin 14 goes L, turning OFF Q105 and Q104. Therefore, the motors stop.

Most automatic tuning systems use a high motor speed to shorten the tuning time. However, when this is done, inertia keeps the motors from stopping immediately after the motor stop signal is issued when the SWR drops below 1.2. This may result in the motors overrunning the range in which the SWR is 1.2 or less; the motor stop signal is then cancelled and the motors again start rotating, but in the opposite direction. In the worst case, this may continue indefinitely. Conversely, if the motor speed is decreased, it takes longer for the tuner to finish tuning.

In the AT-250, the motor speed is controlled as follows. IC106 contains a multivibrator which outputs a triangular wave. This triangular wave signal is applied to IC105 pin 8. Mean while, the SWR signal is applied to IC105 pin 5. As the SWR becomes higher, the output voltage at IC105 pin 1 drops. Therefore, the duty ratio of the pulse signal output from IC105 pin 7 is increased. This pulse signal is applied to Q103 via Q101 to switch power fed to the motors.

When the SWR becomes low, the output voltage at IC105 pin 1 rises and the duty ratio of the pulse signal output from IC105 pin 7 is decreased. Therefore, the motor speed drops. As previously described, the motor speed is controlled by changing the duty ratio of the pulse signal output from IC105.

Band switching information is input to IC2 from the TS-430 via terminals WRC, A2, B2, C2 and D2. (See Table 1.) Relays RL2 to RL8 on the AT unit (X57-1040-00) are controlled to select a tap along the inductor according to this band switching information.

Operating conditions for the relays are shown in Table 2. For the antenna coupling circuit, a "T" network configuration is used when the band selected is 1.4MHz or lower, and "pi" network configuration is used when the band selected is 18MHz or higher. The "T" or "pi" configuration selection is controlled by relay RL1.

While the tuning motors are operating, a voltage signal is output through Control unit (A) LED terminal to illuminate the red LED on the front panel. This indicator extinguishes when tuning is completed.

Tuner indicator D2 (green) located adjacent to the tuner switch on the front panel illuminates when the transmit and receive signals pass through the antenna tuner.

Table 3 lists information on the status of signals at major terminals when the front panel switches and RX IN-OUT switch on the rear panel are selected.

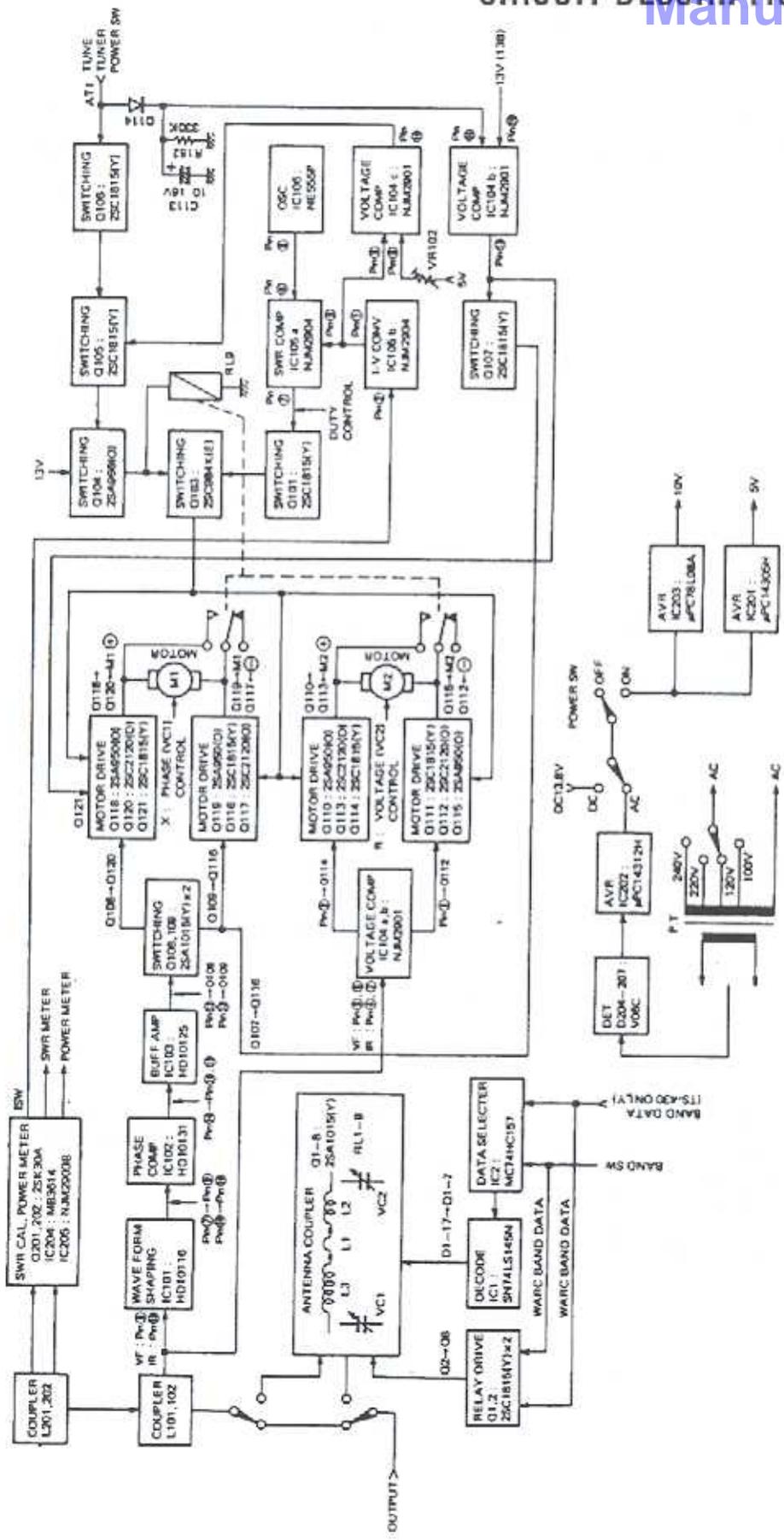


Fig. 1 Block diagram

Terminal Band	SWITCH UNIT (X41-1520-00)				
	D2	C2	B2	A2	WRC
1.8MHz	0	0	1	0	0
3.5	0	0	1	1	0
7	0	1	0	1	0
10	0	1	1	0	1
14	0	1	1	1	0
18	1	0	0	0	1
21	1	0	0	0	0
24.5	1	0	0	1	1
28	1	0	0	1	0

Table 1 Band information

Relay Band	RL2	RL3	RL4	RL5	RL6	RL7	RL8	RL1 (T/ π SW)
	1.8MHz	○	○	○	○	○	×	×
3.5	×	○	○	○	○	×	×	×
7	×	×	○	○	○	×	×	×
10	×	×	×	○	○	×	○	×
14	×	×	×	×	○	×	×	×
18	×	×	×	×	×	×	○	○
21	×	×	×	×	×	×	×	○
24.5	×	×	×	×	×	○	○	○
28	×	×	×	×	×	○	×	○

Table 2 Relay functions

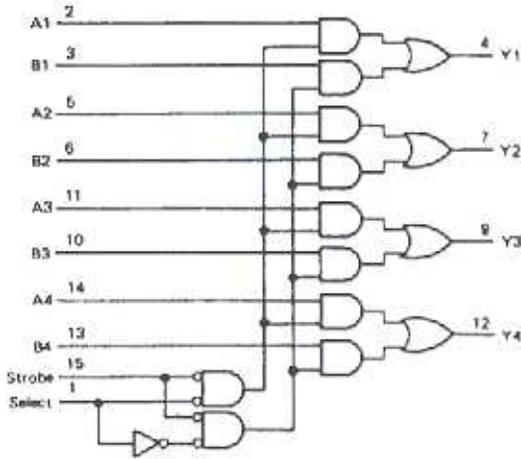
NO.	Tuner operates (Motors rotate)								
	1	2	3	4	5	6	7	8	9
TUNER SW	OFF	ON	ON	ON	ON	ON	ON	ON	ON
TUNE SW	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	ON
RX IN-OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT	IN	IN
TS-430 SEND,REC	REC	REC	SEND	SEND	SEND	REC	SEND	REC	REC
Q102	OFF	OFF	ON	ON	ON	OFF	ON	OFF	OFF
Q108	ON	ON	ON	OFF	OFF	ON	ON	ON	ON
Q105	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
Q104	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
Q103	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
RL101	OFF	OFF	ON	ON	ON	OFF	ON	ON	OFF
③ MB	L	L	L	H	L	L	L	L	L
ATI	H	H	H	L	L	H	H	H	H
② TUN	H	H	L	L	L	H	L	L	H
RL1	L	L	H	H	H	L	H	L	L
① RL2 Note 1.	(H)	(H)	(L)	(L)	(L)	(H)	(L)	(H)	(H)
RLC	H	H	L	L	L	H	L	L	H
TUNER LED	OFF	OFF	ON	ON	ON	OFF	ON	ON	OFF
TUNE LED	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF

The receive signal passes through the antenna tuner only if the TUNER SW is ON, the TUNE SW is OFF, and the RX IN/OUT SW is IN.

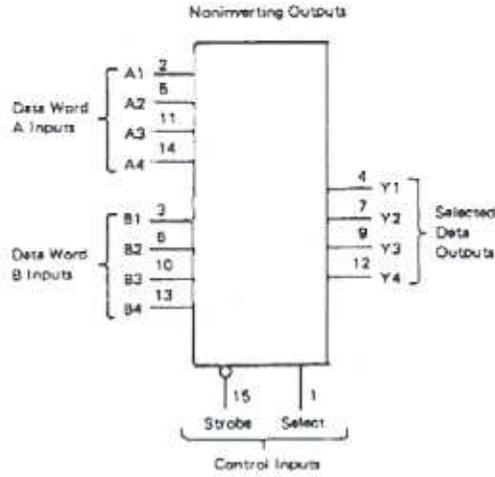
Note 1. A L level is present at STBY SW SEND and a H level at STBY SW REC when a unit other than a TS-430S is connected by the accessory cable (B).

Table 3

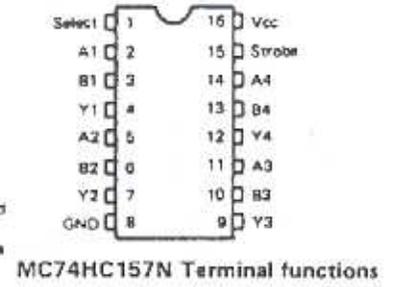
SEMICONDUCTOR DATA



MC74HC157N Logic circuit (SW unit IC2)



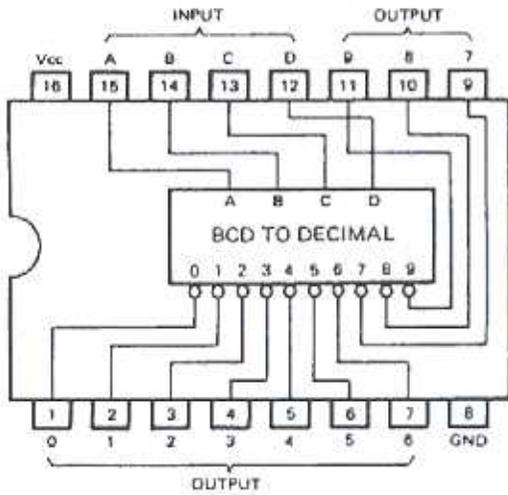
MC74HC157N Block diagram



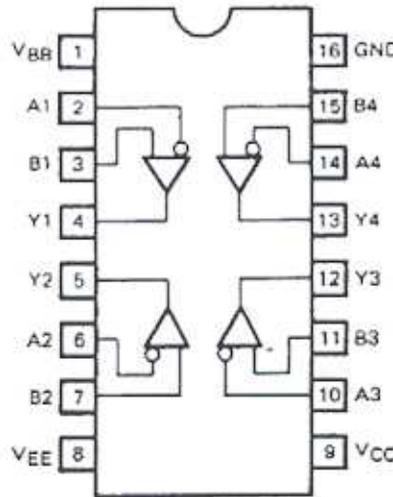
MC74HC157N Terminal functions

Inputs		Output Y		
Strobe	Select	A	B	HC157
H	X	X	X	L
L	L	L	X	L
L	L	H	X	H
L	H	X	L	L
L	H	X	H	H

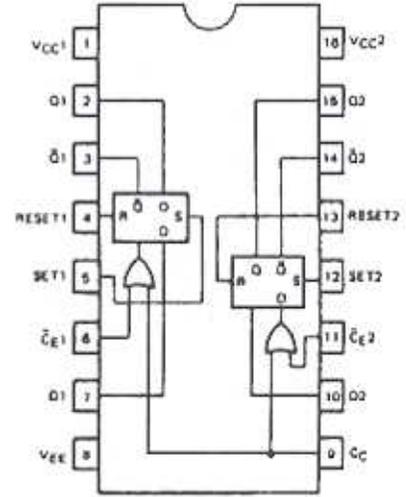
MC74HC157N Truth table



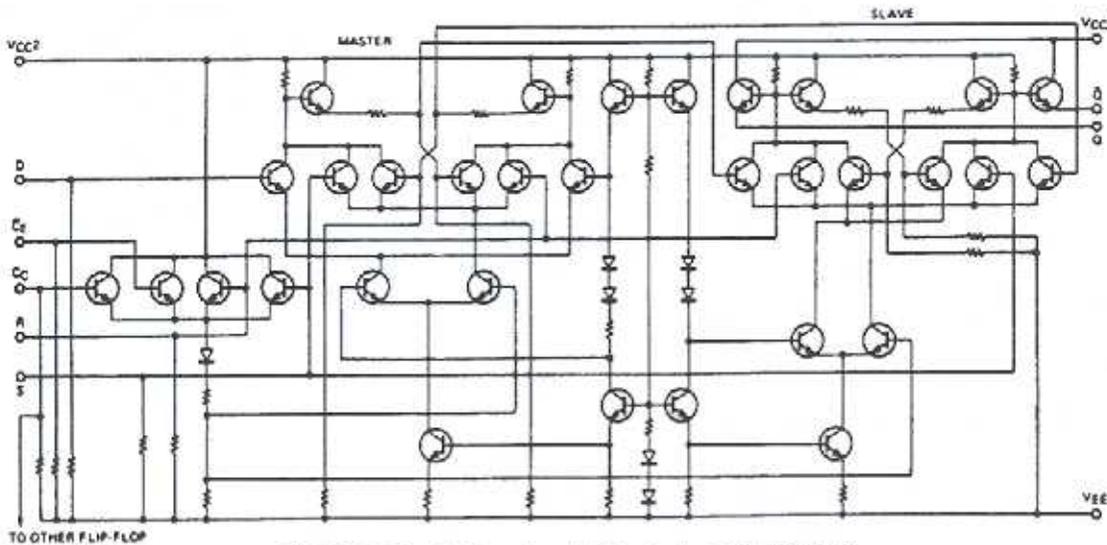
SN74LS145N (SW unit IC1)



HD10125 (TOP VIEW)
(Control unit (A) IC103)

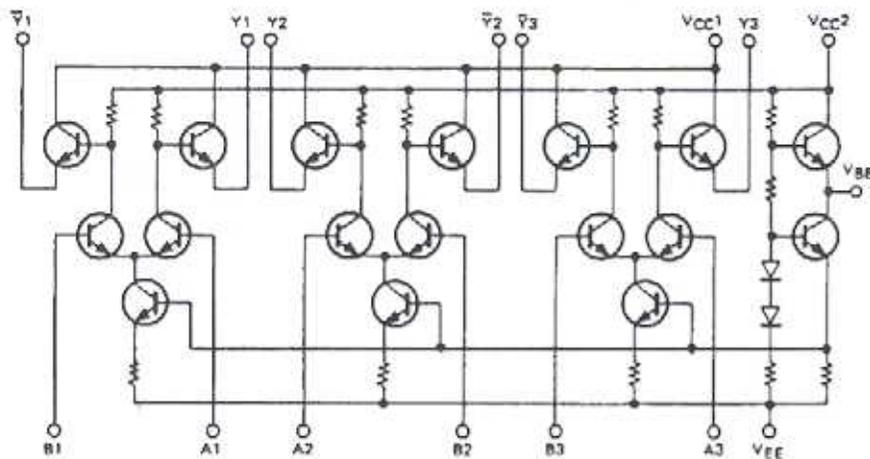


HD10131 (TOP VIEW)
(Control unit (A) IC102)

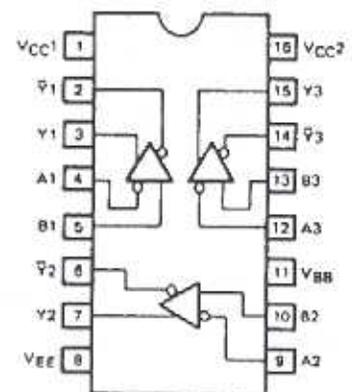


HD10131 Equivalent circuit (Control unit (A) IC102)

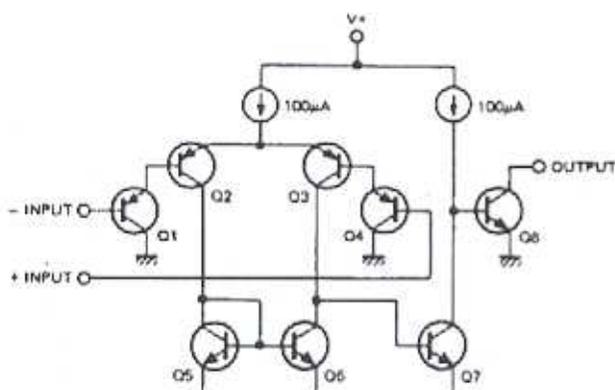
SEMICONDUCTOR DATA



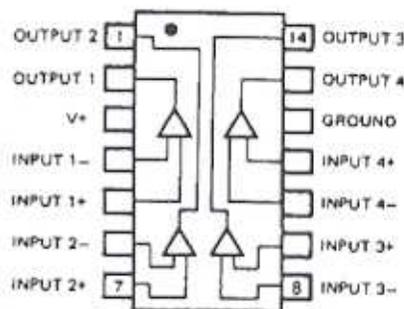
HD10116 Equivalent circuit (Control unit (A) IC101)



HC10116 (TOP VIEW)



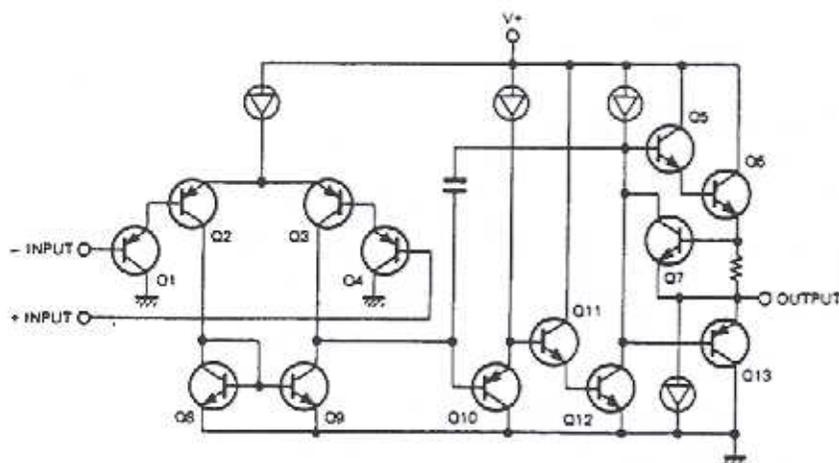
NJM2901 Equivalent circuit (Control unit (A) IC104)



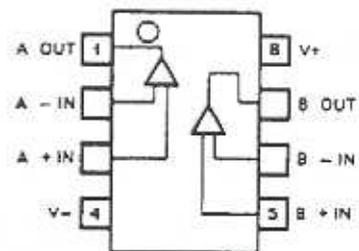
NJM2901 (TOP VIEW)

Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	V_s	P_T	V_{IDR}	V_{ICR}	T_{opr}	T_{stg}
Rating	36V	570mW	36V	-0.3 ~ +36V	-40 ~ +85°C	-50 ~ +125°C

NJM2901 MAX. Rating ($T_a = 25^\circ\text{C}$)



NJM2904D Equivalent circuit (Control unit (A) IC105)

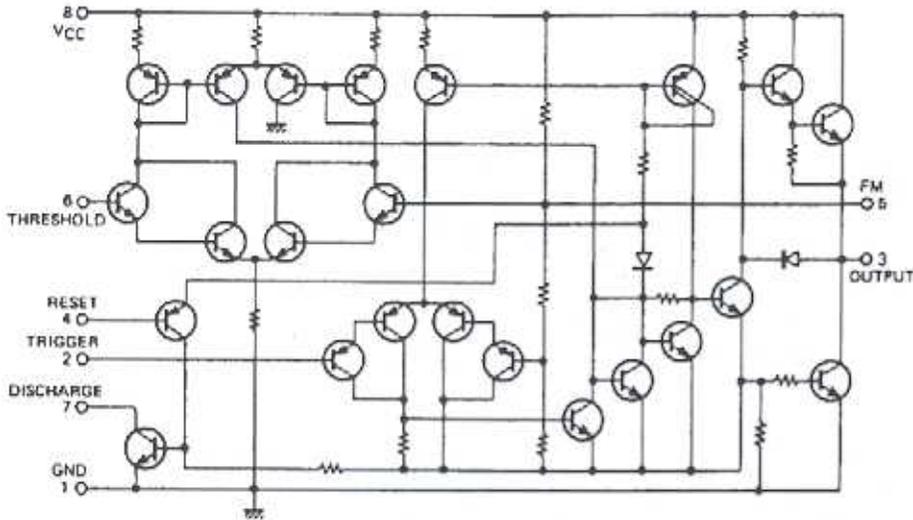


NJM2904D (TOP VIEW)

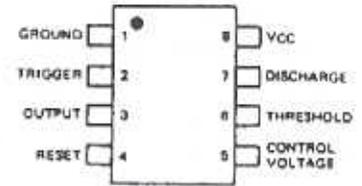
Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	V_s	P_T	V_{ID}	V_{ICM}	T_{opr}	T_{stg}
Rating	32 ± 18V	500mW	-0.3 ~ +26V	-0.3 ~ +32V	-20 ~ +75°C	-40 ~ +125°C

NJM2904D MAX. Rating ($T_a = 25^\circ\text{C}$)

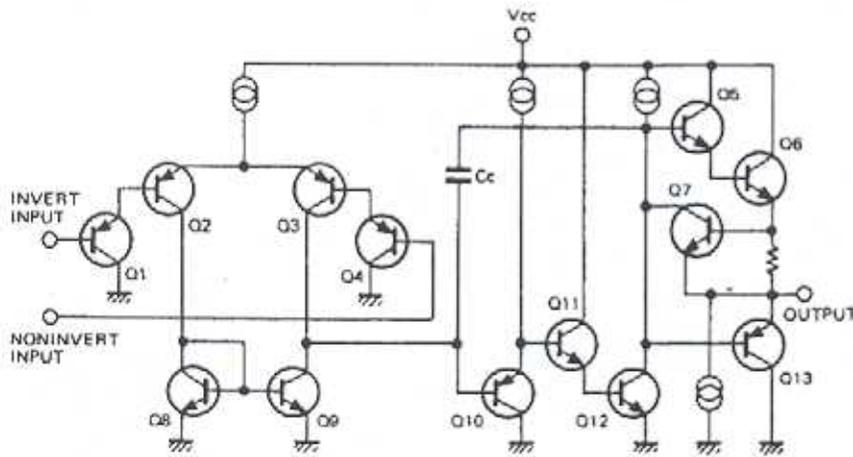
SEMICONDUCTOR DATA



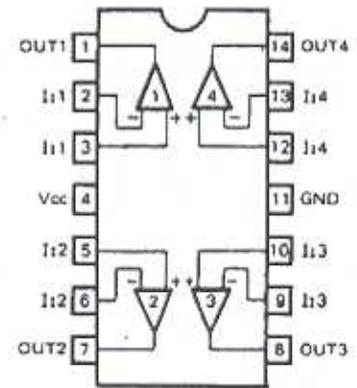
NE555P Equivalent circuit (Control unit (A) IC106)



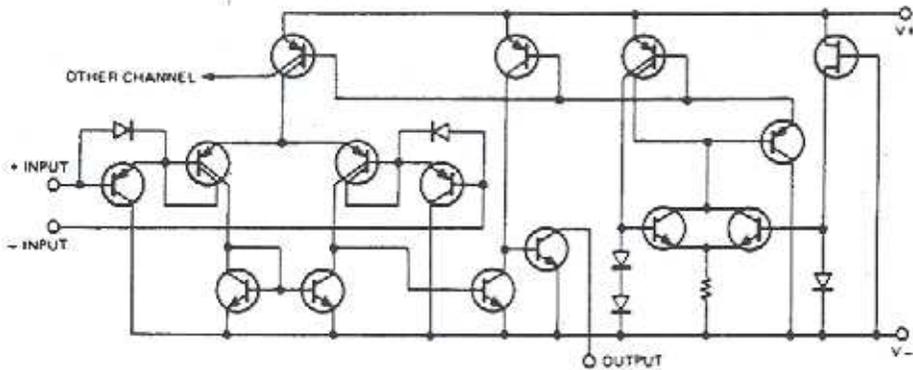
NE555P (TOP VIEW)



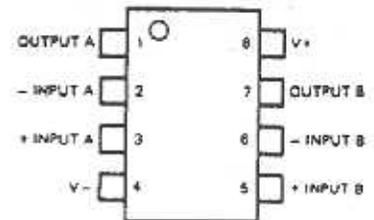
MB3614 Equivalent circuit (Control unit (B) IC204)



MB3614 (TOP VIEW)

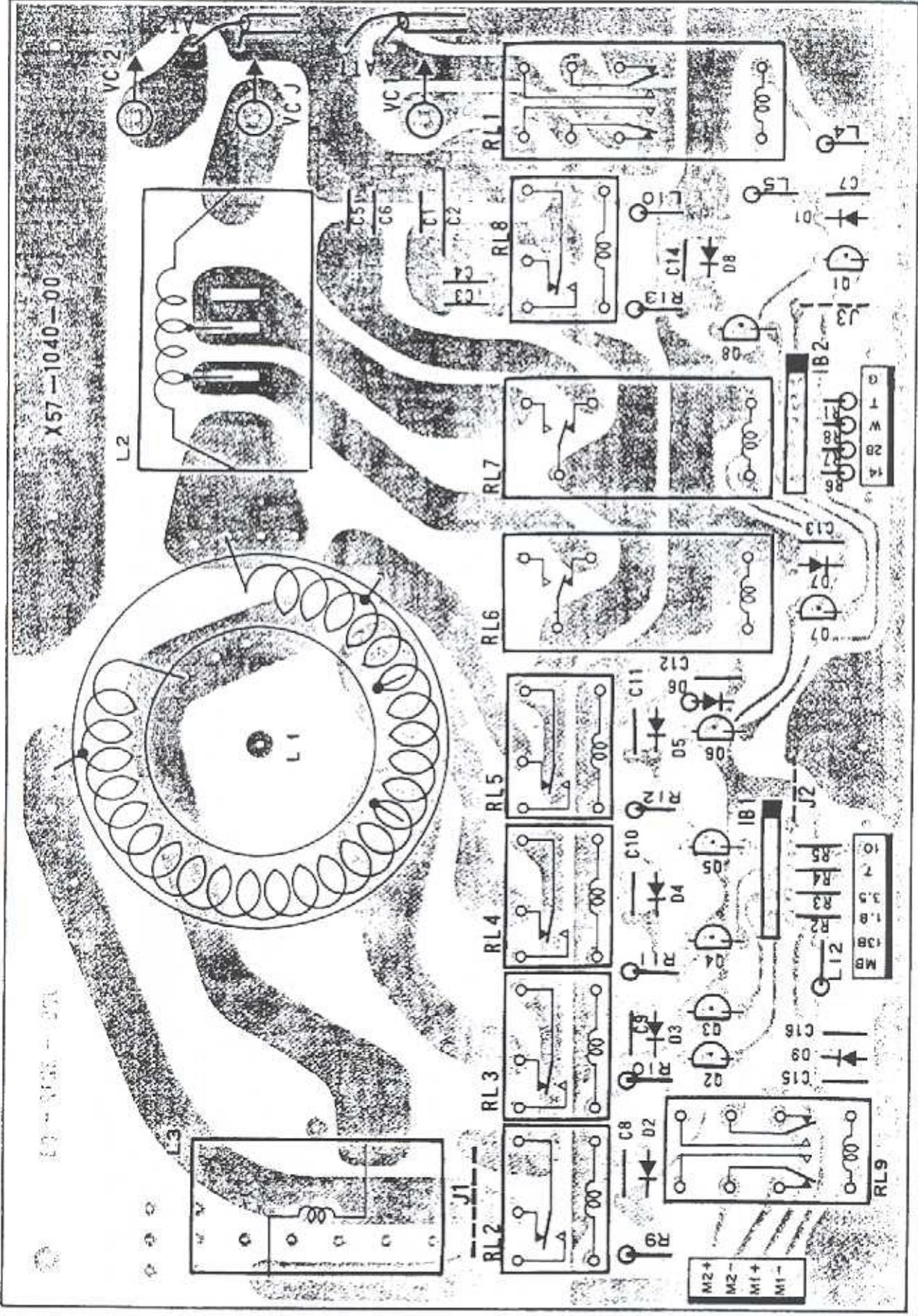


NJM2903D Equivalent circuit (Control unit (B) IC205)



NJM2903D (TOP VIEW)

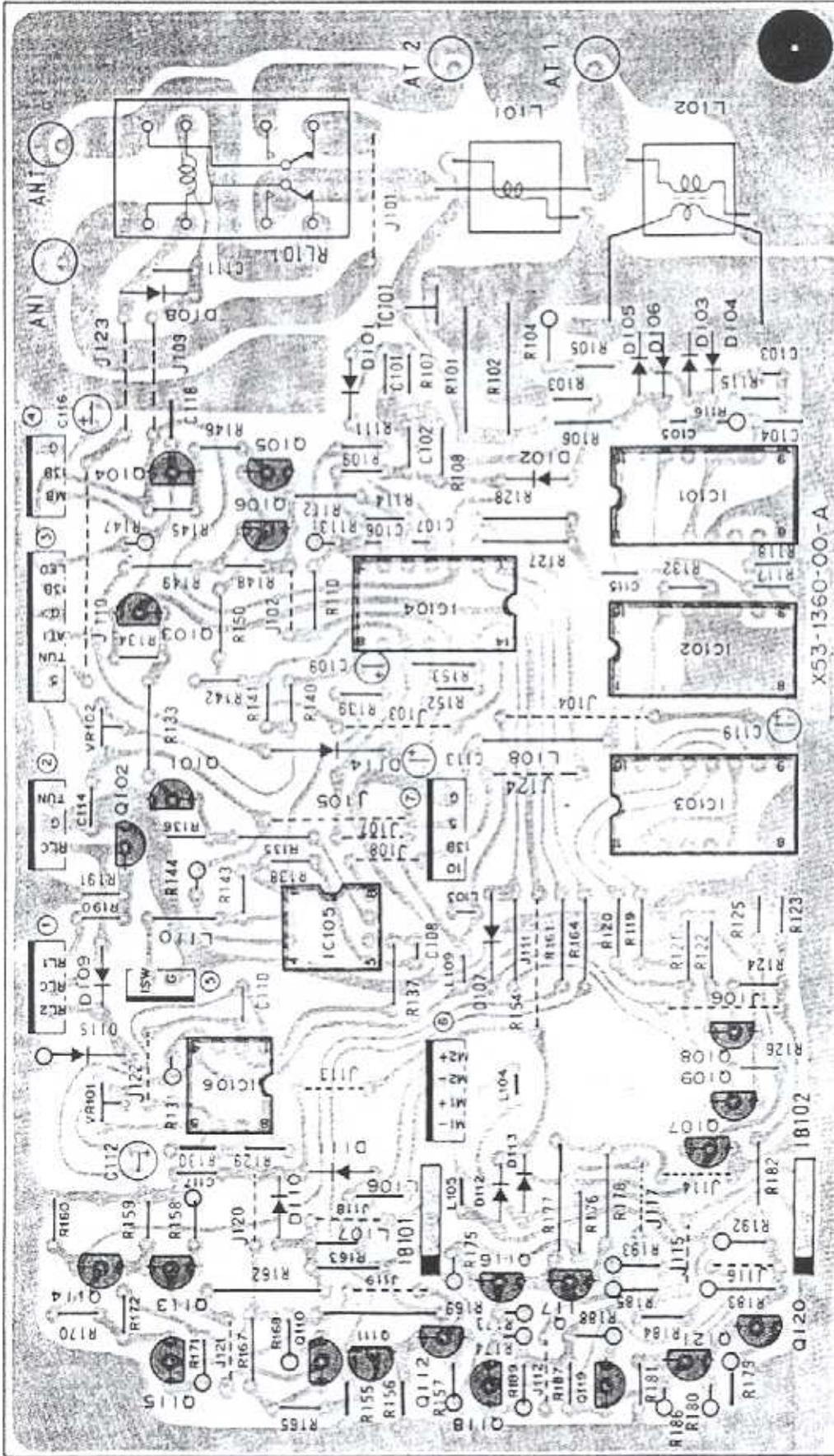
AT UNIT (X57-1040-00) Component side view



Q1-B 2SA1015(Y) D1-9 1S1555 or 1N4448

PC BOARD VIEW

CONTROL UNIT (X53-1360-00) (A) Component side view



- X53-1360-00-A
- IC101 : HD10116 IC102 : HD10131 IC103 : HD10125 IC104 : NJM2801 IC105 : NJM2804D IC106 : NE555P
 - Q110,115,118,119 : 2SA950(G) Q104 : 2SA966(K) Q103 : 2SA966(K) Q108,109 : 2SA1015(V) Q101,102,105-107,111,114,116,121 : 2SC1815(Y)
 - Q112,113,117,120 : 2SC2120(M)
 - D103-106 : 1S599 D101,102 : 1N60 D107,108,110-114 : 1S1555 or 1N4448 D109 : V08J D115 : U15J

CONTROL UNIT (X53-1360-00) (B) Component side view

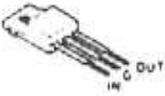
- 25A950
- 25A966
- 25A984K
- 25A1015
- 28C1815
- 28C2120



25K30A



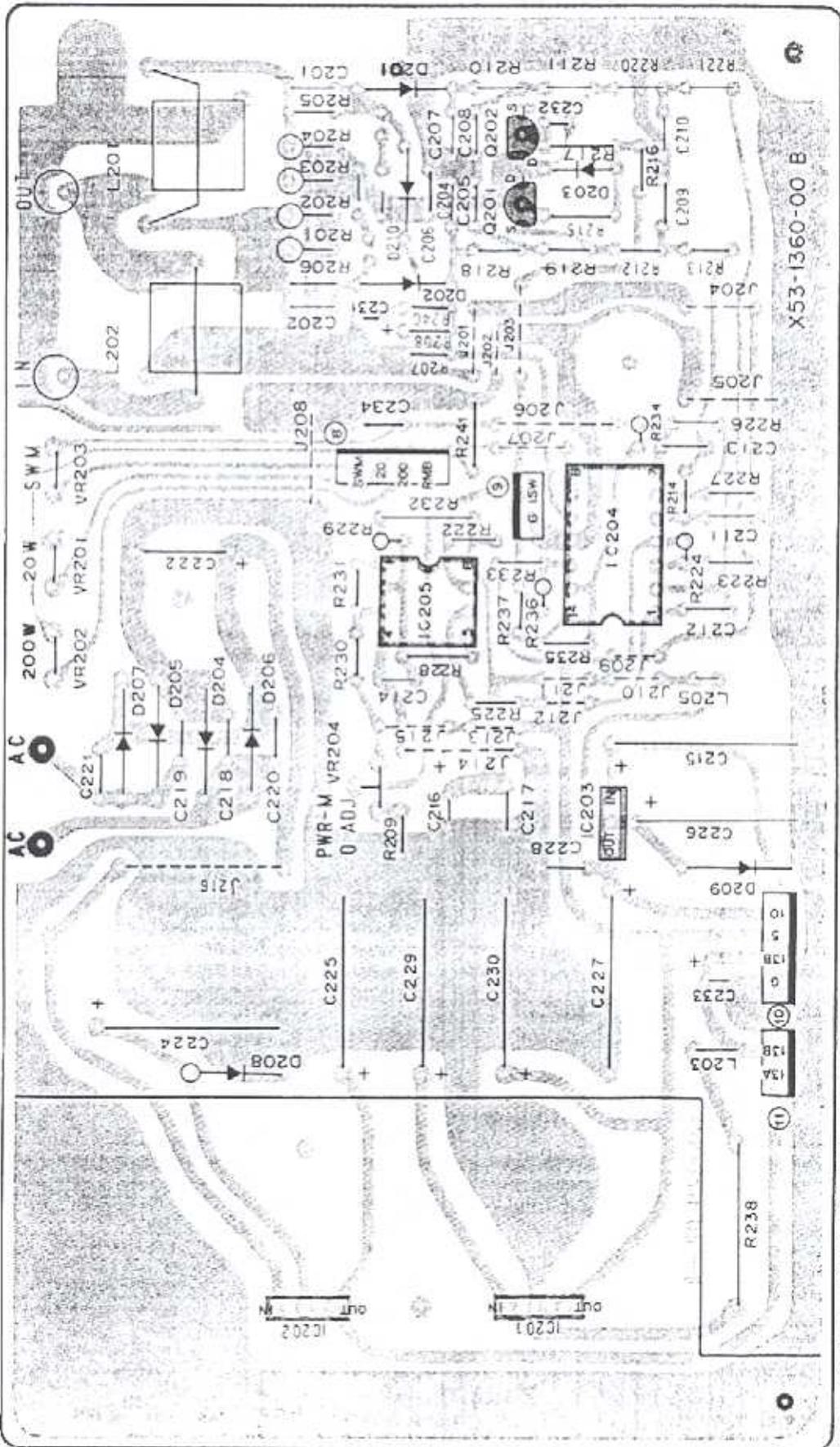
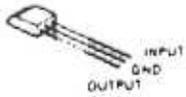
μPC14305H



μPC14312H



μPC78L08A



- IC201 : μPC14305H IC202 : μPC14312H IC203 : μPC78L08A IC204 : M83814 IC205 : NJM2903D
- D201,202 : 25K30A(GR)
- D204--207 : V03C D208,209 : LT8001P D201,210 : 1S1587 D202 : 1S1007 D203 : 1S1555 or 1N4448

PARTS LIST

CAPACITORS

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

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

● 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

Cord	C	D	G	J	K	M	X	Z	P	No cord
(%)	± 0.25	± 0.5	± 2	± 5	± 10	± 20	+ 40	+ 80	+ 100	More than 10µF - 10 ~ + 50 Less than 4.7µF - 10 ~ + 75

Less than 10 pF

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

Abbreviation		Abbreviation	
Cap	Capacitor	ML	Mylar
C	Ceramic	S	Styren
E	Electrolytic	T	Tantalum
MC	Mica		

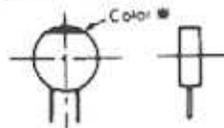
● Rating voltage

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	-

● Capacitor value

- 0 1 0 = 1pF
 - 1 0 0 = 10pF
 - 1 0 1 = 100pF
 - 1 0 2 = 1000pF = 0.001µF
 - 1 0 3 = 0.01µF
 - 2 2 0 = 22pF
- 1st number | Multiplier
2nd number

CC45



Symbol	Destination
K	U.S.A.
W	Europe
T	Britain
M	General market

Resistors not listed in this parts list are standard, fixed carbon composition, 1/4 or 1/8W.

The resistors values, in ohms, are indicated on the schematic diagram.

N : New parts

Δ : Please note that parts are sometimes not in stock and it takes much time to deliver.

SEMICONDUCTOR

Name	Re-marks	Part No.	Name	Re-marks	Part No.
Diode		1N60	IC		HD10116
		1N4448		HD10125	
		1S1007		HD10131	
		1S1555		MB3614	
		1S1587		N	MC74HC157N
		1SS99			NE555P
LED	N	U05B			NJM2901
		U15J			NJM2903D
		V03C			NJM2904D
		V08J			SN74LS145N
		LT8001P		µPC78L08A	
TR		SG238D		µPC14305H	
		SR535D		µPC14312H	
	N	2SA950(O)			
		2SA986(O)			
		2SA984K(E)			
		2SA1015(Y)			
FET		2SC1815(Y)			
		2SC2120(O)			
		2SC2235(O)			
		2SK30(GR)			

Part No.	Re-marks	Description	Ref. No.
AT-250 GENERAL			
A01-0960-02	N	Case (upper)	
A01-0961-02	N	Case (lower)	
A20-2494-03	N	Panel	K,M,W
A20-2495-03	N	Panel	T
A23-1476-03	N	Rear panel	
B09-0003-05		Coupling	
B30-0822-05		Pilot lamp 14V, 80mA	PL1
B31-0645-06	N	Meter	M1
B39-0407-04		Spacer x 2 Assistant foot	
B40-2673-04	N	Name plate	K,M,W
B40-2674-04	N	Name plate	T
B41-0626-14		Voltage indication plate 120V	K
B41-0627-14		Voltage indication plate 220V	M,W
B41-0630-04		Voltage indication plate 240V	T
B46-0404-00		Warranty card	K
B50-4066-00	N	Instruction manual	
CC45CH2H150J	C	150P 500V	C6
CC45CH2H220J	C	22P 500V x 3	C16-18
CC45CH2H330J	C	33P 500V	C5
CK45F1H103Z	C	0.01 x 8	C7-13,15
C91-0079-05	C	0.01 2kV	C1
C91-0456-05	C	0.047	C4
C91-0496-05	C	470P x 2 AC150V	C2,3

Part No.	Remarks	Description	
E04-0152-05		M type receptacle x 5	J1-5
E06-0852-05		BP DIN socket ACC	J6
E07-0751-05		7P DIN plug	
E07-0851-05		BP DIN plug	
E08-0203-25		2P connector DC POWER	J7
E18-0351-05		3P inlet AC POWER	J8
E30-1643-15		AC cord ass'y Accessory KJM	
E30-1644-15		AC cord ass'y Accessory T	
E30-1645-05		AC cord ass'y Accessory W	
E30-1747-05	N	Remote cable (A) Accessory 8P-8P	
E30-1748-05	N	GND cable Accessory	
E31-2199-05	N	Connector with lead LED	
H01-4515-04	N	Packing carton (inside)	
H10-2567-02		Packing fixture (F)	
H10-2568-02		Packing fixture (R)	
H12-1319-04		Cushion	
H20-1420-03		Protective cover	
H25-0105-04		Protective bag Cable	
J02-0323-05		Foot x 4	
J02-0427-04		Assistant foot	
J21-2573-04		Foot mounting hardware x 2	
J32-0768-04		Hex. boss x 3	
J61-0401-05		Nylon band x 10	
K23-0753-04		Pointer knob x 3 ANT,METER,BAND	
K29-0758-04		Push knob x 2 POWER,TUNER	
K29-0787-04	N	Push knob x 2 TUNE	
L01-8074-05	N	Transformer	T1
N09-0258-05		GND screw x 3	
N09-0641-05		Round screw x 2	
N14-0115-05		Flange nut GND	
N14-0509-05		Wing nut GND	
N15-1026-41		Flat washer	
N15-1040-46		Flat washer x 2 GND	
N30-2004-41		Round screw x 2	
N30-2606-41		Round screw x 4	
N30-3006-41		Round screw x 10	
N30-4016-48		Round screw GND	
N32-2606-41		Flat screw x 2	
N33-3006-45		Round flat screw x 2	
N35-3006-41		Bind screw x 17	
N87-2506-41		Self tapping screw	
N87-3006-41		Self tapping screw x 12	
N87-3012-46		Self tapping screw x 8	
N89-3005-46		Blind tapping screw x 4	
S01-1434-05	N	Rotary switch ANT1-4	S6
S29-1413-05		Voltage selector 100V-240V	S5
S31-1407-05		Slide switch RX IN/OUT	S3
S31-2027-05		Slide switch AC/DC	S4
S40-2414-05		Push switch TUNER	S2
S40-2448-05	N	Push switch POWER	S1
X41-1520-00	N	Switch unit	
X53-1360-00	N	Control unit (A), (B)	
X57-1040-00	N	AT unit	

Part No.	Remarks	Description	Ref. No.	Qty
SWITCH UNIT (X41-1520-00)				
CK45F1H103Z		C 0.01	C2	1
C91		C 0.047	C1,3	2
E10-0652-05	N	Wire holder Mini connector 5P Mini connector 8P		2 1 1
		Ferrite inductor 150µH	L1	1
		Inline block 0.01 x 4	1B1,2	2
R90-0533-05		Resistor block 4.7kΩ x 7	RB2	1
R90-0571-05	N	Resistor block 10kΩ x 8	RB3	1
		Resistor block 33kΩ x 4	RB1	1
R92-0150-05		Short jumper		12
S01-1435-05	N	Rotary switch BAND	S1	1
	N	Rotary switch METER	S3	1
S40-2433-05		Push switch TUNE	S2	1
CONTROL UNIT (X53-1360-00) (A), (B)				
C05-0324-05	N	Ceramic trimmer 60P	TC101	1
CC45CH1H101	C	100P	C201,202	2
CC45SL1H470J	C	47P	C232	1
CE02W0J101M	E	100 6.3V	C224,226	2
CE02W1C101M	E	100 16V	C215,225,227,229, 230	5
CE04W1C100M	E	10 16V	C112,113,119	3
	E	100 16V	C216	1
	E	10 25V	C116	1
	E	47 25V	C233	1
	E	1 50V	C109	1
	E	0.47 50V	C231	1
	C	0.001	C103,105-108	5
	C	0.0022	C204,207	2
	C	0.01	C101,102,111 218-221,234	8
	ML	0.033	C110	1
	ML	0.0056	C214	1
	E	2200 25V	C222	1
	C	0.047	C104,114,115,117, 118,206,209-213, 217,228	13
	C	0.022	C205,208	2
		Coax. connector		6
		Round terminal		2
		Jumper wire		28

Part No.	Re- marks	Description	Ref. No.	Q'ty	Part No.	Re- marks	Description	Ref. No.	Q'ty
E40-0273-05		Mini connector 2P		2	AT UNIT (X57-1040-00)				
E40-0373-05		Mini connector 3P		3					
E40-0473-05		Mini connector 4P		3	C02-0022-05		Variable cap.	VC1,2	2
E40-0673-05		Mini connector 6P		1	CC45CH2H121J	C	120P 500V	C2	1
E40-3007-05		Pin connector 2P		1	CC45CH2H330J	C	33P 500V	C4	1
E40-3009-05		Pin connector 4P		1	CC45CH2H470J	C	47P 500V	C3	1
					CC45CH2H820J	C	82P 500V	C1,5,8	3
F01-0799-04	NA	Heat sink		1	CK45F1H103Z	C	0.01	C7-16	10
F20-0078-05		Insulating plate		1					
F29-0014-05		Shoulder washer		1					
J31-0502-04		PC board collar		8	D22-0408-05		Coupling		2
J42-0428-05		PC board bushing		8	D40-0623-25		Gear ass'y 1/200		1
					D40-0624-25		Gear ass'y 1/300		1
L39-0415-15		Detector coil A	L102	1	E40-0473-05		Mini connector 4P		1
L39-0416-05		Detector coil B	L101,202	2					
L39-0419-05	N	Detector coil	L201	1	J19-1363-05		Lead holder		2
L40-1011-12		Ferri-inductor 100μH	L103-107,110,203	7	J61-0401-05		Nylon band		1
L40-1011-13		Ferri-inductor 100μH	L108	1	L34-2194-05	N	Tuning coil A	L1	1
L40-1021-12		Ferri-inductor 1mH	L109	1	L34-2195-05	N	Tuning coil B	L2	1
L40-1511-12		Ferri-inductor 150μH	L205	1	L34-2196-05	N	Tuning coil C	L3	1
N10-2030-41		Nut		2	L40-1011-12		Ferri-inductor 100μH	L4,5,10,12	4
N30-3010-41		Round screw		2	N09-0641-05		Round screw		4
N87-3006-41		Self tapping screw		1	N87-3006-41		Self tapping screw		11
					N88-3006-41		Flat tapping screw		4
R12-2401-05		Trim. pot. 5kΩ (B)	VR201,203	2	R90-0188-05		Inline block 0.01 x 4	IB1,2	2
R12-2410-05		Trim. pot. 5kΩ (B)	VR102,204	2	R92-0150-05		Short jumper		2
R12-3434-05		Trim. pot. 10kΩ (B)	VR101	1	S51-1417-05		Relay	RL5,7	2
R12-3440-05	N	Trim. pot. 20kΩ (B)	VR202	1	S51-1420-05	N	Relay	RL2-5,8	5
RC05GF2H101J		Solid 100Ω 1/2W	R101,102,201-204	6	S51-2413-05	N	Relay	RL1	1
RC05GF2H4R7J		Solid 4.7Ω 1/2W	R162,169	2	S51-2414-05	N	Relay	RL9	1
RS14AB3D470J		MF 47Ω 2W	R238	1	T42-0303-05		Motor	M1,2	2
R90-0570-05	N	Inline block	IB101,102	2					
R92-0150-05		Short jumper		11					
S51-2407-05		Relay	RL101	1					

ADJUSTMENT

REQUIRED TEST EQUIPMENT

1. DC voltmeter (DVM)

- 1) Input resistance: More than $1M\Omega$
- 2) Voltage range: 1.5 to 1000V AC/DC

Note: A high-precision multimeter may be used. However, accurate readings can not be obtained for high-impedance circuits.

2. Power meter

- 1) Frequency limits: 60MHz or greater
- 2) Impedance: 50Ω
- 3) Dissipation: 20W continuous or greater, 150W continuous or greater

3. RF Dummy Load

- 1) Impedance: 20Ω , 150Ω
- 2) Dissipation: 150W or greater

Note: The length of both the 150Ω and 20Ω dummy load cables must be 10cm or less.

4. DC Power Supply

- 1) DC 13.8V
- 2) Capacity: 0.6A or greater

5. Oscilloscope

PREPARATION

Unless otherwise specified, set the controls as follows.

Front panel

POWER SW	OFF
TUNER SW	OFF
TUNE SW	OFF
METER SW	200W
ANT SW	ANT1
BAND SW	AUTO

Caution: Do not change the setting of the AT-250's BAND switch while the TS-430S is in other than the receive mode.

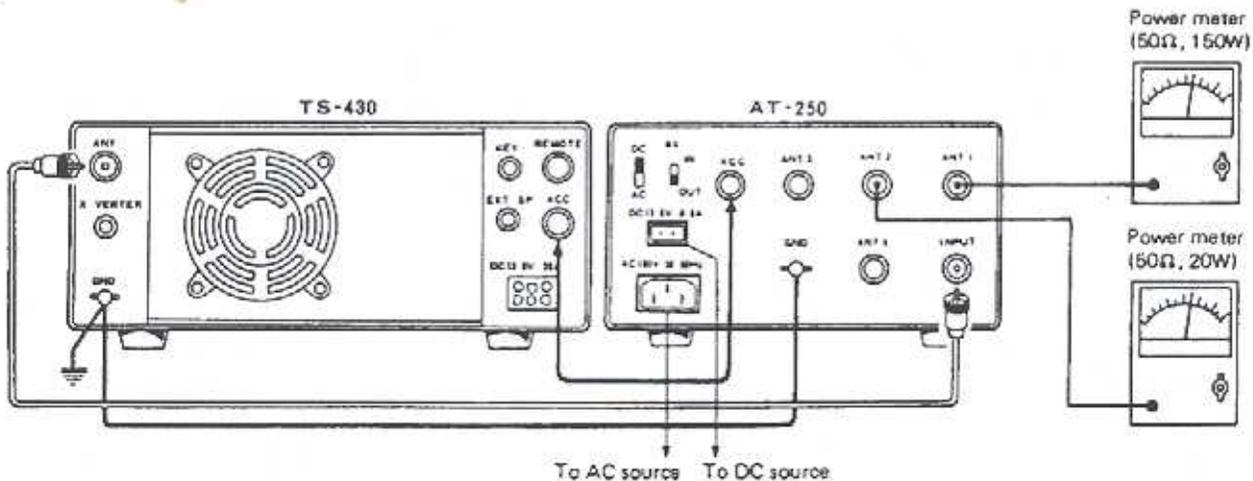
Rear panel

RX IN/OUT SW	OUT
AC/DC SW	DC

DC connector: Connect a 13.8V DC power supply, 0.6A or greater capacity.

ANT1: Connect a 50Ω , 150W power meter.

ANT2: Connect a 50Ω , 20W power meter.



ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. Voltage check	1) Power SW : ON							Meter lamp lights.
		DVM	Cont. (A)	13B 15				13.8V±0.5V 5V±0.5V
	2) Power SW : OFF							
2. Meter zero-point adjustment	3) AC/DC SW : AC (Connect to AC power.) Power SW : ON							
	1) Meter SW : 200W, 20W, SWR	(AT-250) Pow.meter SWR meter			Cont. (B)	VR204	Adjust VR204 so the meter always just reads zero when the meter switch is switched between the 20W and 200W and SWR positions.	
	3) Power meter adjustment and check							
3. Power meter adjustment and check	1) Meter SW : 200W ANT SW : ANT1 TS-430S f : 14.175MHz MODE : CW STBY : SEND CAR control : Adjust to where the power meter (50Ω, 150W) reads 90W.	(AT-250) Pow.meter 50Ω, 150W			Cont. (B)	VR202	Adjust VR202 to where the AT-250's power meter reads 90W.	Confirm that the AT-250's power meter reads 90±9W on all bands.
	2) Meter SW : 20W ANT SW : ANT2 Set the TS-430S's power to 10W.	Pow.meter 50Ω, 20W				VR201	Adjust VR201 to where the AT-250's power meter reads 10W.	Confirm that the AT-250's power meter reads 10±1W on all bands.
	3) Meter SW : 200W ANT SW : ANT1 TS-430S MODE : USB MIC control : Set so the ALC meter defects at voice peaks within the ALC zone.							Confirm that the AT-250's power meter reads about 90W at voice peaks.
4. SWR meter and duty cycle adjustment	1) Meter SW : SWR ANT1 : Power meter (50Ω, 150W) ANT2 : 150Ω, 50W dummy load ANT3 : 20Ω, 50W dummy load TS-430S f : 14.175MHz MODE : CW STBY : SEND	Pow.meter 50Ω, 150W 150Ω dummy load 20Ω dummy load (AT-250) SWR meter			Cont. (B)	VR203	Set the AT-250's ANT switch to ANT1 and adjust the TS-430S's CAR control to obtain a power output of 50W. Return to receive mode. Then, set the ANT switch to ANT2, transmit and adjust VR203 so the SWR reading is 3 : 1. Note) The length of both the 150Ω and 20Ω dummy load cables must be 10cm or less.	
	2) Transmit on all bands with the ANT switch to ANT2 and then to ANT3 to confirm that the SWR meter reading is correct.							AT-250's SWR meter reading; 2.5 to 3.5 with 150Ω dummy load 2.0 to 3.0 with 20Ω dummy load
	3) ANT SW : ANT4 (Open) TS-430S STBY : SEND						Check	Confirm that the AT-250's SWR meter swings to "∞" or beyond.
	4) ANT SW : ANT1 TUNER SW : ON TUNE SW : ON TS-430S f : 1.8MHz MODE : CW Power output : 50W STBY : SEND	Oscillo- scope	Cont. (A)	IC105 pin 7	Cont. (A)	VR101	Set the TUNE switch to OFF after automatic tuning is finished. Change the TS-430S frequency to obtain an SWR reading of 2. Then, adjust VR101 for a wave form at 50% duty cycle.	 A = B (Duty 50%)

ADJUSTMENT

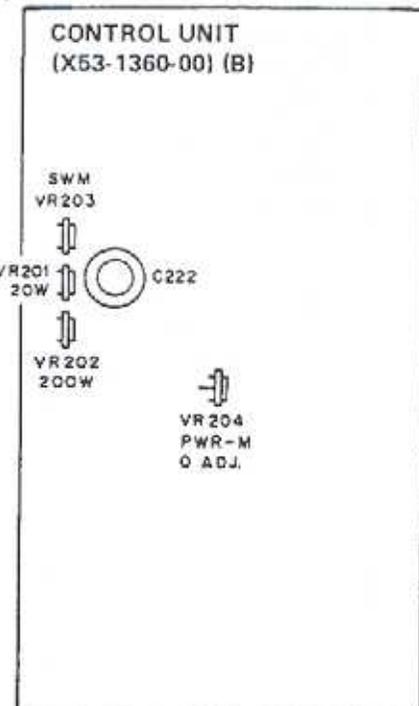
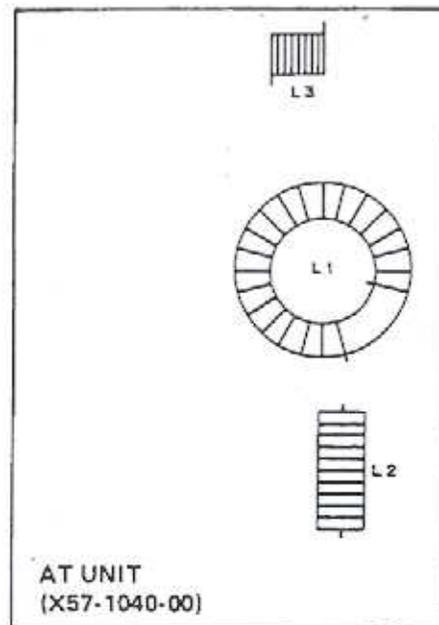
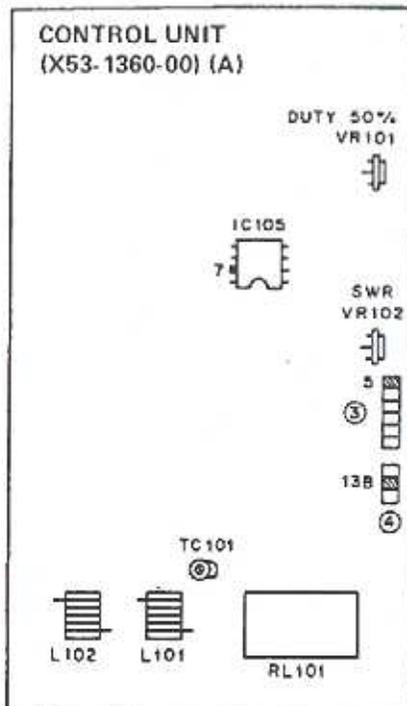
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
5. SWR reference voltage adjustment	1) Meter SW : SWR ANT SW : ANT1 TUNER SW : ON TUNE SW : ON TS-430S f : 1.9MHz MODE : CW Power : 50W STBY : SEND	Pow.meter 50Ω,150W (AT-250) SWR meter			Cont. (A)	VR102	Turn VR102 to the left (to the 10 o'clock position). The motors will stop when the SWR reading is approx. 1.5. Adjust VR102 so that the motors stop when the SWR reading is 1.15. Confirm that the motors stop when the SWR reading is 1.15 even if the TS-430S's encoder knob is turned. (This is easily achieved on the 1.9MHz band because the SWR reading exceeds 1.15 when the encoder frequency is changed just 10kHz.)	
	2) TUNER SW : OFF TS-430S f : 29.7MHz STBY : SEND						Check (Check the SWR reading when the antenna tuner is bypassed.)	The AT-250's SWR meter should read 1.2 or less. (If the reading is greater than 1.2, move the 2-turn coil, part of L201 on Control unit (B), toward the toroidal core to obtain an SWR of 1.2 or less.)
6. SWR meter check	1) TUNER SW : OFF TUNE SW : OFF ANT SW : ANT1 Meter SW : SWR TS-430S f : All bands MODE : CW STBY : SEND	Pow.meter 50Ω,150W (AT-250) SWR meter					Check	The AT-250's SWR meter should read 1.2 or less.
7. Automatic tuner operation check	1) ANT1 : Power meter (50Ω,150W) ANT2 : 150Ω dummy load ANT3 : 20Ω dummy load TUNER SW : ON TUNE SW : ON TS-430S f : 1.8, 3.5, 7, 10, 14, 18, 21, 24.5, 28MHz MODE : CW Power output : 50W STBY : SEND Caution) Do not change the setting of the AT-250's BAND switch while the TS-430S is in other than the receive mode.	Pow.meter 50Ω,150W 150Ω dummy load 20Ω dummy load					Transmit on each band with the ANT switch set to ANT1 and the BAND switch to AUTO and confirm that the tuner automatically tunes to the optimum point. Set the ANT switch to ANT2 (ANT3) and make test transmissions on each band. Confirm that the tuner automatically tunes to the optimum point. Note 1) TC101 must be set to the 90 degree position as shown at right. If motor operation is unstable on the 18MHz band, adjust TC101 to where the motors stop when the SWR is 1.15.	The motor should stop within 15 seconds after automatic tuning is started (with the TUNE LED OFF) and the SWR should be less than 1.2. Tuning should be done automatically when the ANT switch is switched to ANT2 or ANT3 position or when the BAND switch is switched from one band position to another. Note) Be sure to stop transmission if the motors do not stop within 15 seconds, then transmit again to resume tuning. It should not be necessary to repeat this more than 5 times.

TC101



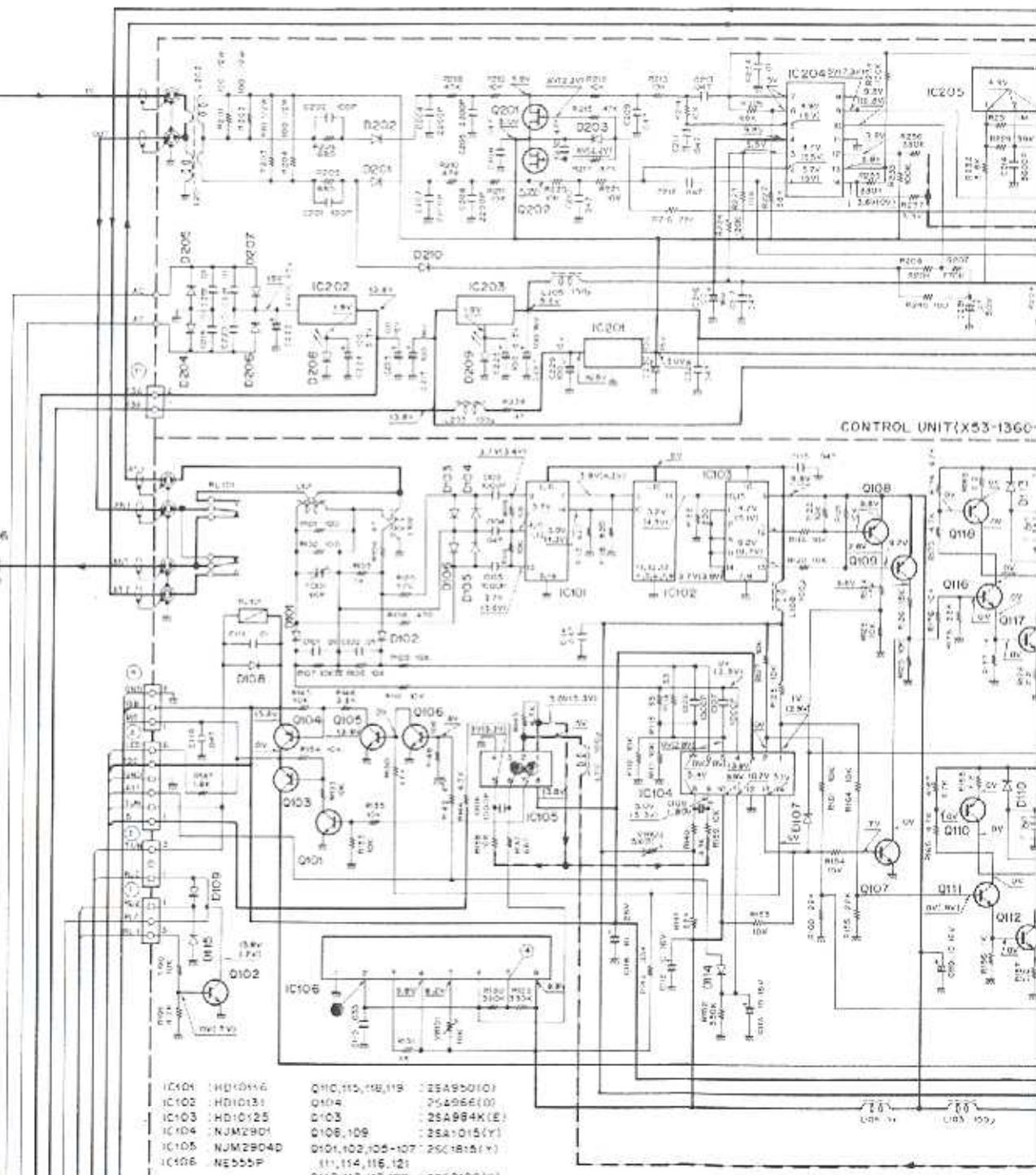
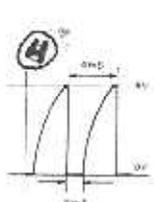
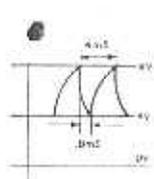
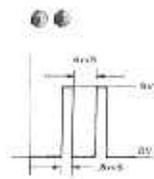
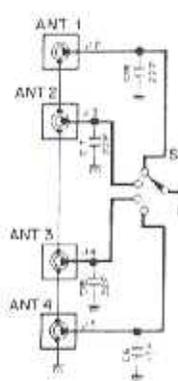
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
8. Checking AT operation at low power	1) TUNER SW : ON TUNE SW : ON ANT SW : ANT1 Connect a 50Ω, 20W power meter to the ANT1 terminal. TS-430S f : 1.8-29.7MHz MODE : CW Power output : 3W STBY : SEND	Pow. meter 50Ω, 20W						Set the TUNER switch to OFF and adjust the TS-430S CAR control so that the 50Ω, 20W power meter reads 3W. Set the TUNER switch to ON and confirm that the tuner operates correctly.
9. Power loss check	1) ANT SW : ANT1 Connect a 50Ω, 150W power meter to the ANT1 terminal. Meter SW : 200W BAND SW : AUTO TUNER SW : ON TUNE SW : ON TS-430S f : 1.90MHz MODE : CW STBY : SEND	Pow. meter 50Ω, 150W						After tuning is completed with 50W power output, turn the TUNER switch to OFF and adjust the CAR control to where the power meter reads 90W. Measure the difference in power with the TUNER switch ON and OFF.



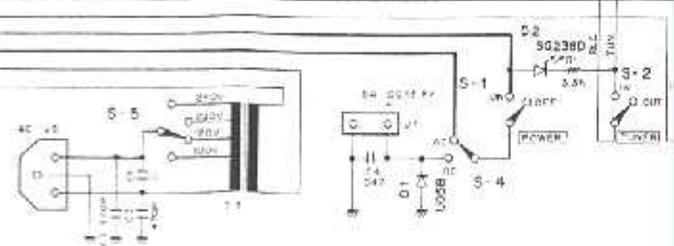
— Signal Line — Control Line — Common DC Line

- IC201 : VFC14305H
- IC202 : VFC14312H
- IC203 : VFC7810BA
- IC204 : MB3614
- IC205 : NJM2903D
- Q201,202 : 2SK3016R
- D204-207 : V03C
- D208,209 : L1A0001
- D201,210 : 1S1587
- D202 : 1S1007
- D203 : 1S1555 or 1N4448



- IC101 : HD10116
- IC102 : HD10131
- IC103 : HD10125
- IC104 : NJM2901
- IC105 : NJM2904D
- IC106 : NE555P
- Q101,115,118,119 : 2SA9501(O)
- Q104 : 2S4966(O)
- D103 : 2SA984K(E)
- Q106,109 : 2SA1015(Y)
- Q101,102,105-107 : 2SC1818(Y)
- 111,114,116,121 : 1S1555
- Q112,113,117,120 : 2SC2100(O)

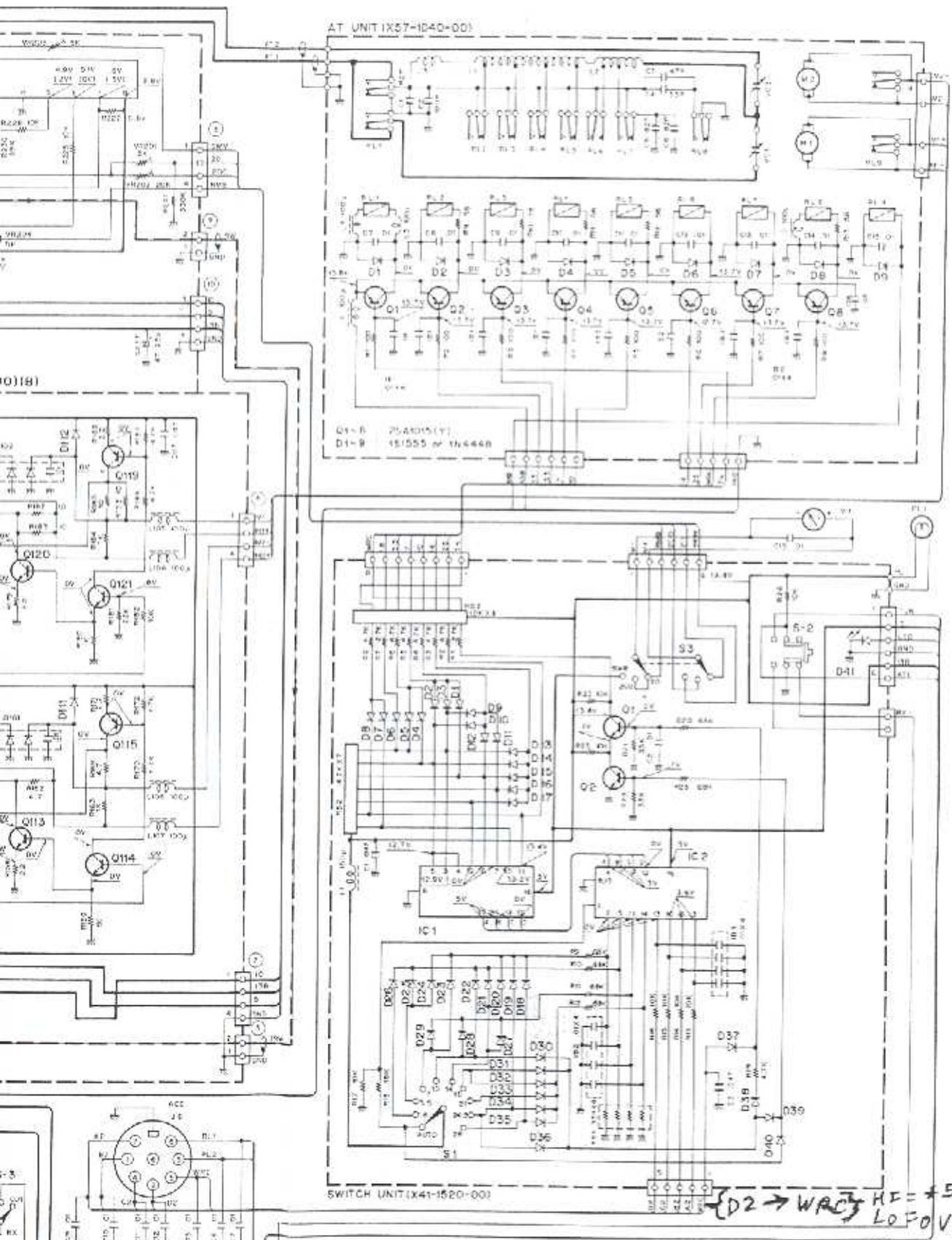
- D103-106 : 1S599
- D101,102 : 1N60
- D107,108,110-114 : 1S1555 or 1N4448
- D109 : V06J
- D115 : 115J



AT-250

DIAGRAM

The voltages measured when receiving. () : TX.
 TS-430S's frequency : 14.175MHz.
 BAND SW : AUTO, TUNER SW : ON, TUNE SW : ON



- | | | | |
|-------|--------------|---------|--------------------|
| IC1 | : 5N74LS145N | D1 - 40 | : 1S1555 or 1N4448 |
| IC2 | : MCT4HC157N | D41 | : 5R555D |
| Q1, 2 | : 2SC1815(Y) | | |

D2 → WAC HF = +5VDC
 L0 F0 VDC
 WHEN IN USE WITH TS-430S + ACC CABLE.
 19

2
3
4
5
6