

B&B

# KENWOOD

# SERVICE MANUAL

# AT-250

## AUTOMATIC ANTENNA TUNER



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## CIRCUIT DESCRIPTION

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 waveform-shaped 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 6. 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 14MHz 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.





## CIRCUIT DESCRIPTION

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

○ : ON  
× : OFF

NO.	Tuner operates (Motors rotate) → Tuner function completed (Motors stop)									
	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	
Q106	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	
③ AT1	H	H	H	L	L	H	H	H	H	
② TUN	H	H	L	L	L	H	L	L	H	
① 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	

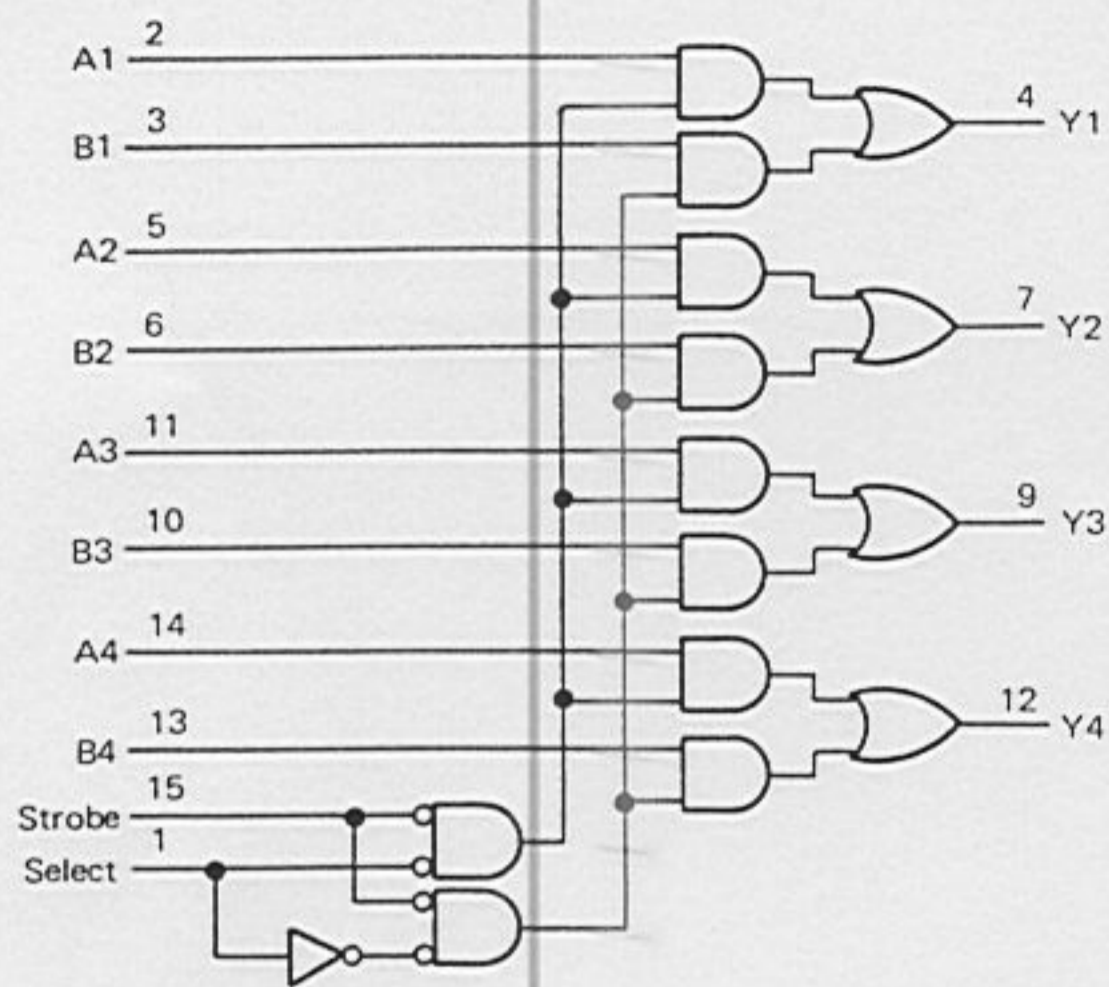
The receive signal passes through the antenna tuner only if the TUNER SW is ON, the TUNE SW is OFF, and the RX IN/OUT SW is IN.

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).

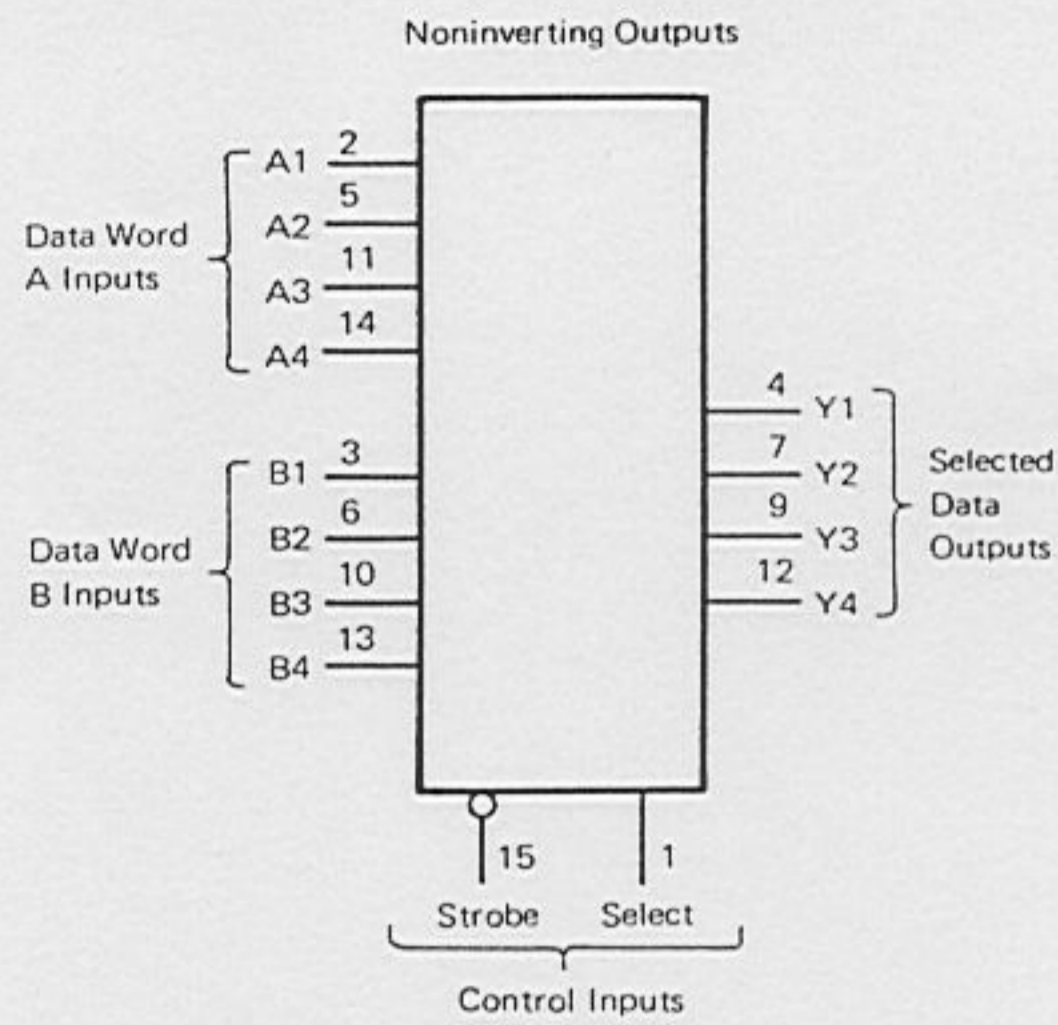
Table 3



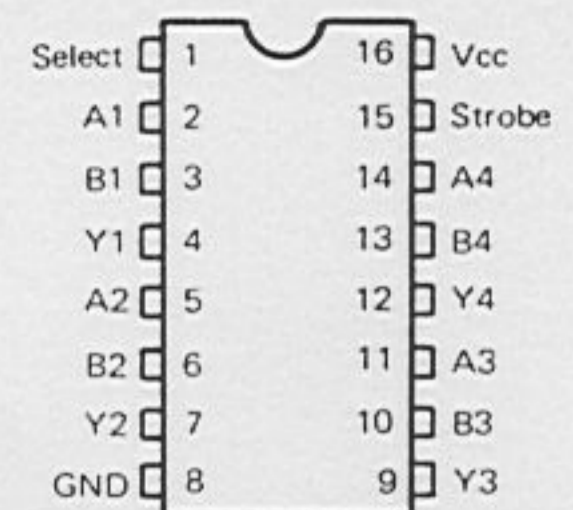
## SEMICONDUCTOR DATA



MC74HC157N Logic circuit (SW unit IC2)



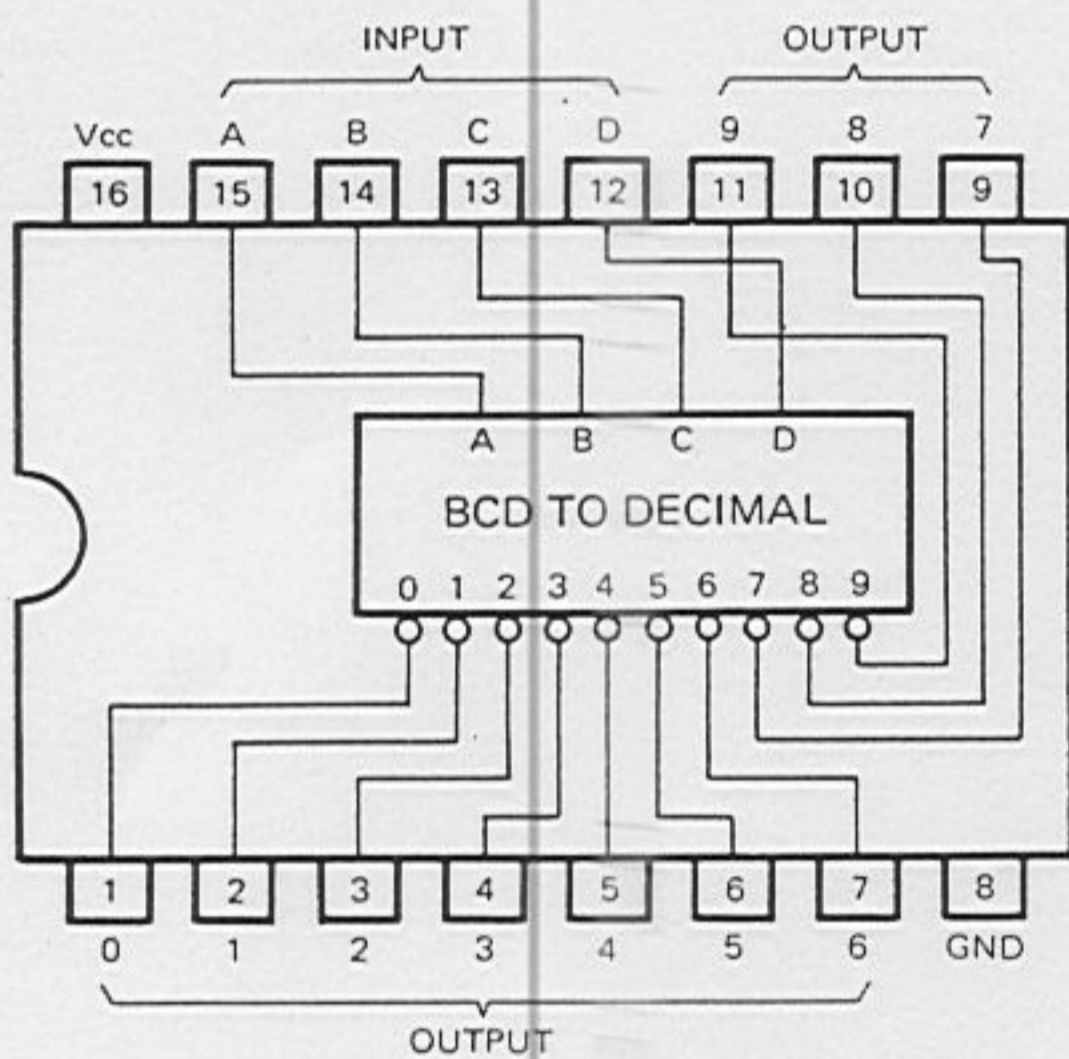
MC74HC157N Block diagram



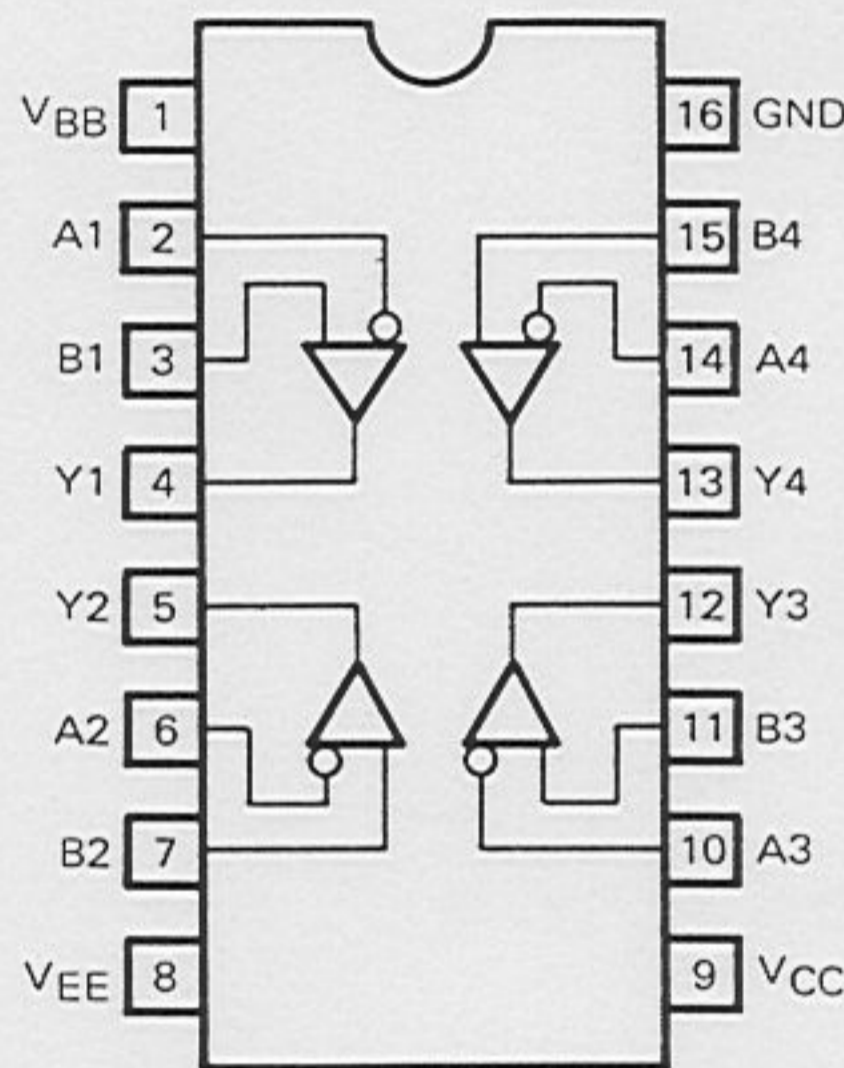
MC74HC157N Terminal functions

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

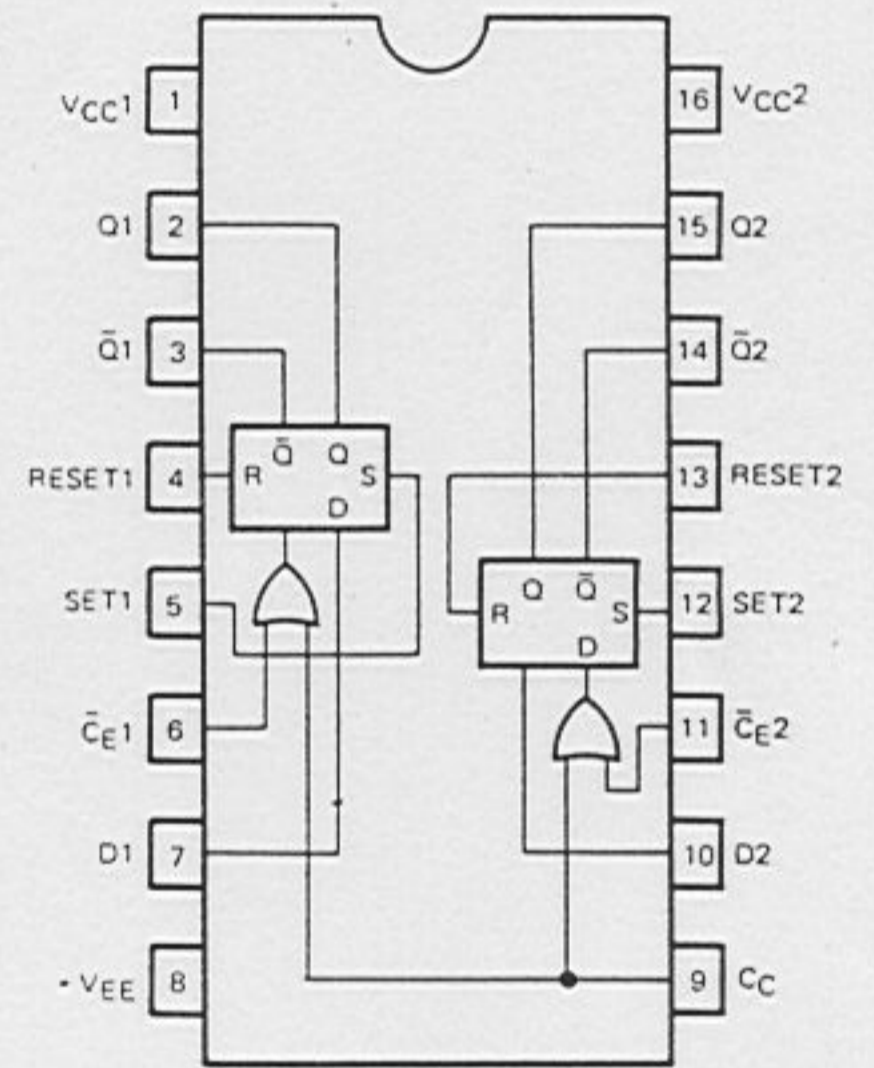
MC74HC157N Truth table



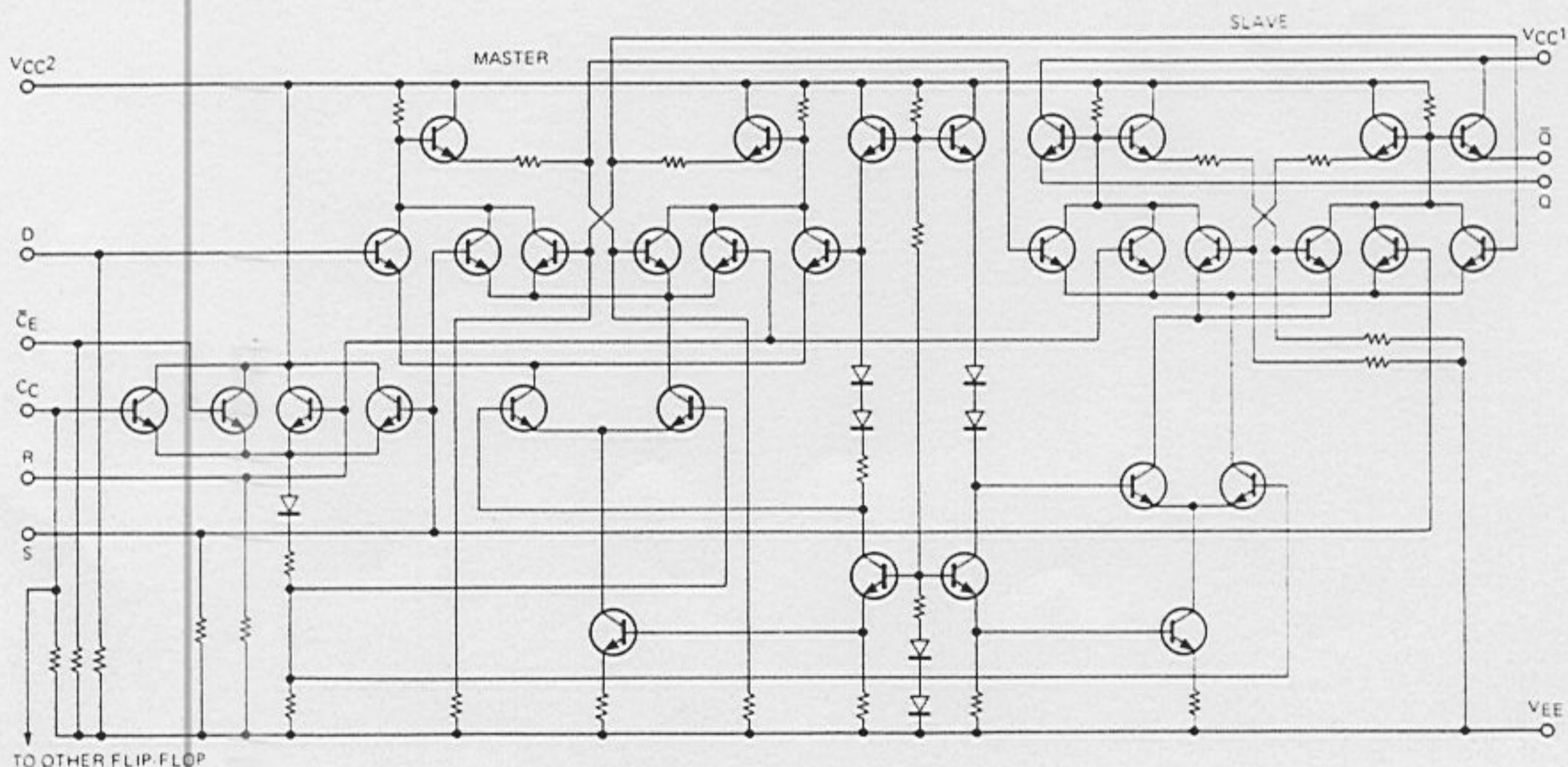
SN74LS145N (SW unit IC1)



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



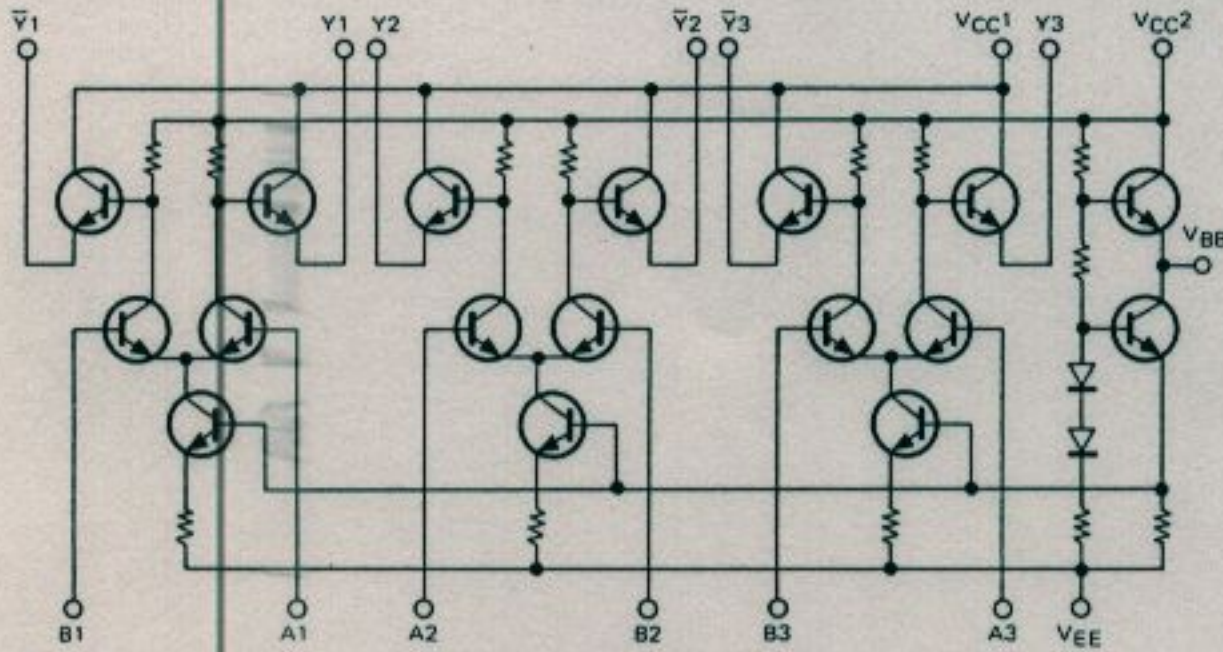
HD10131 (TOP VIEW)  
(Control unit (A) IC102)



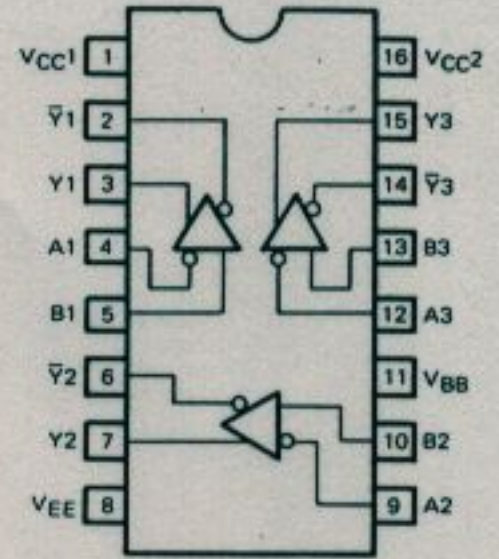
HD10131 Equivalent circuit (Control unit (A) IC102)



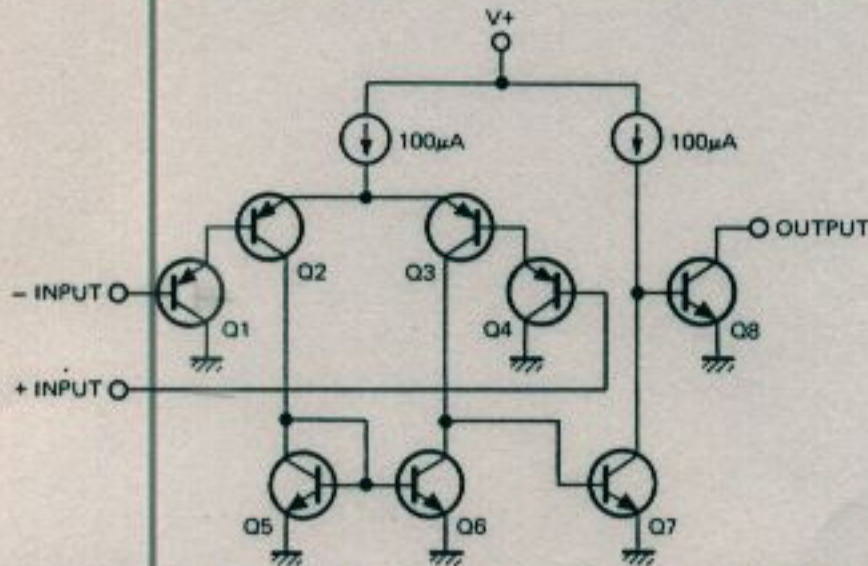
## SEMICONDUCTOR DATA



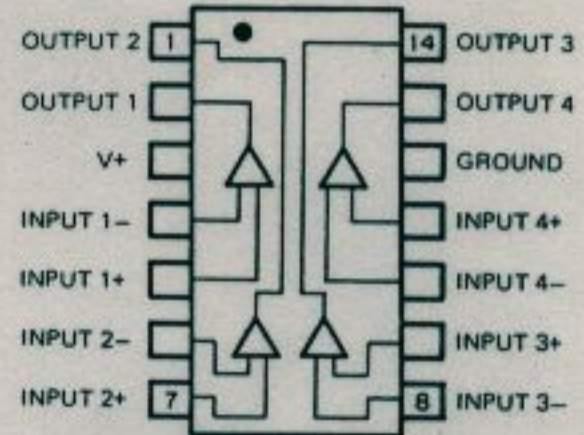
**HD10116 Equivalent circuit (Control unit (A) IC101)**



**HC10116 (TOP VIEW)**



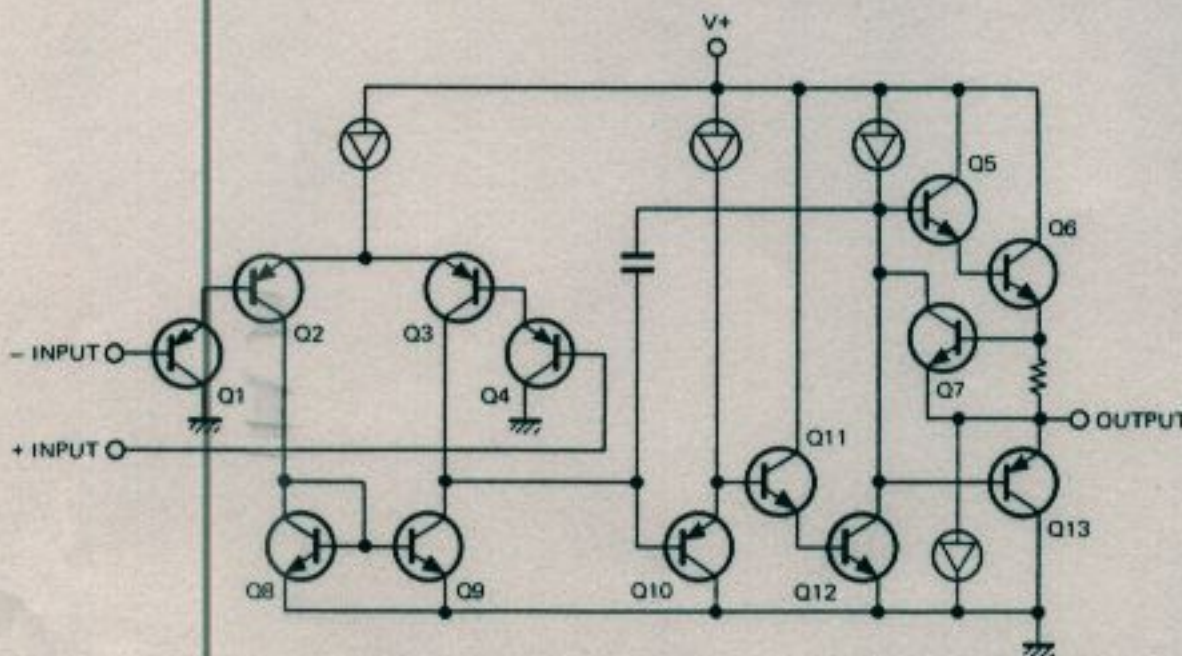
**NJM2901 Equivalent circuit (Control unit (A) IC104)**



**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

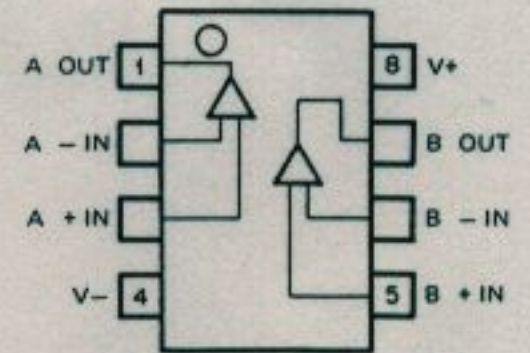
**NJM2901 MAX. Rating ( $T_a=25^\circ\text{C}$ )**



**NJM2904D Equivalent circuit (Control unit (A) IC105)**

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±16V	500mW	-0.3~+26V	-0.3~+32V	-20~+75°C	-40~+125°C

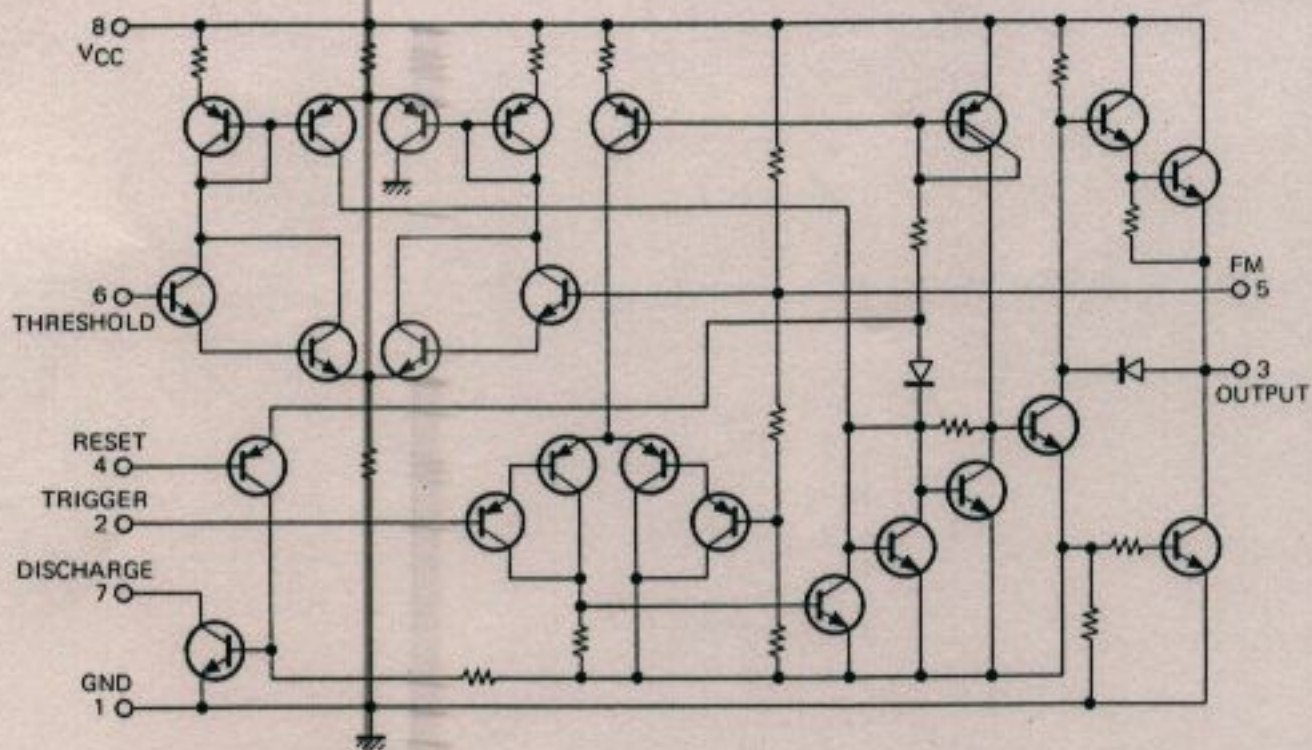
**NJM2904D MAX. Rating ( $T_a=25^\circ\text{C}$ )**



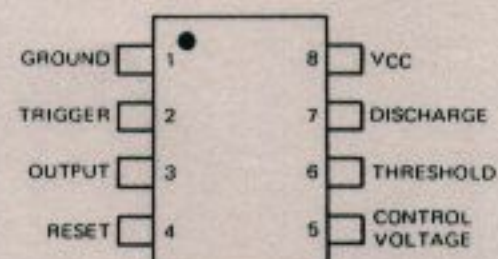
**NJM2904D (TOP VIEW)**



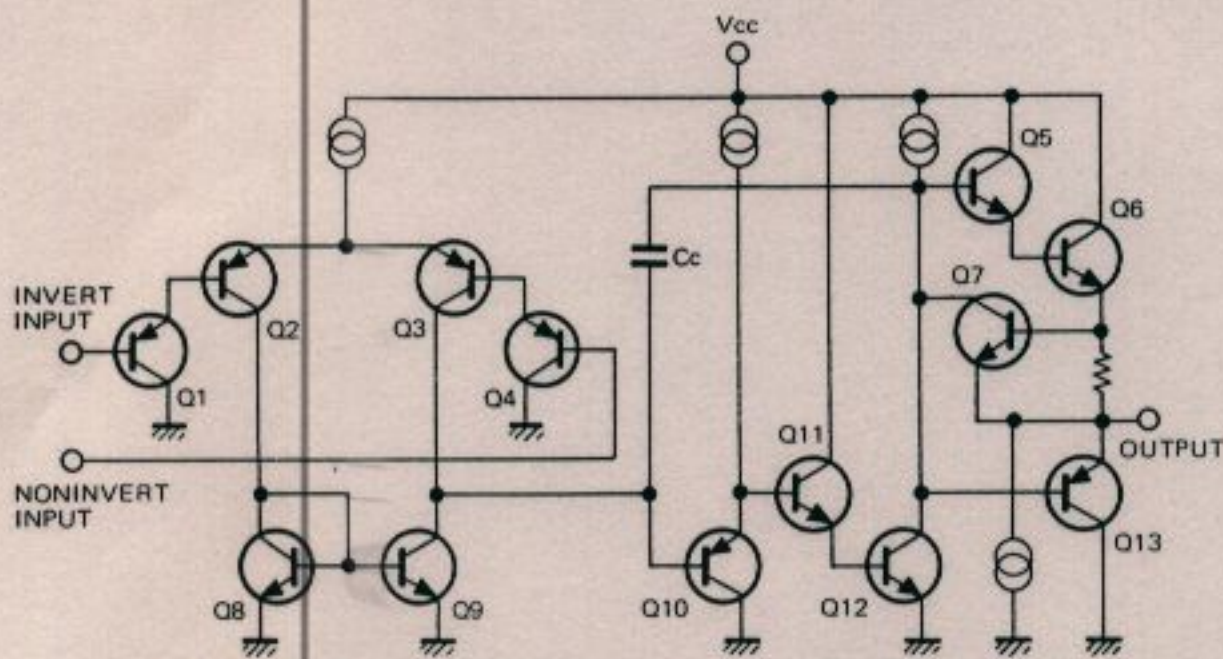
## SEMICONDUCTOR DATA



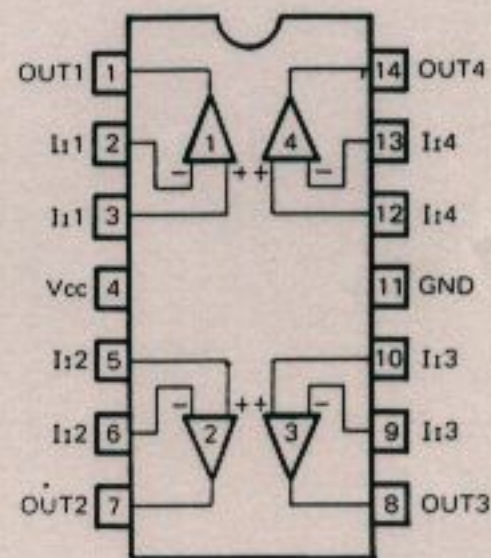
NE555P Equivalent circuit (Control unit (A) IC106)



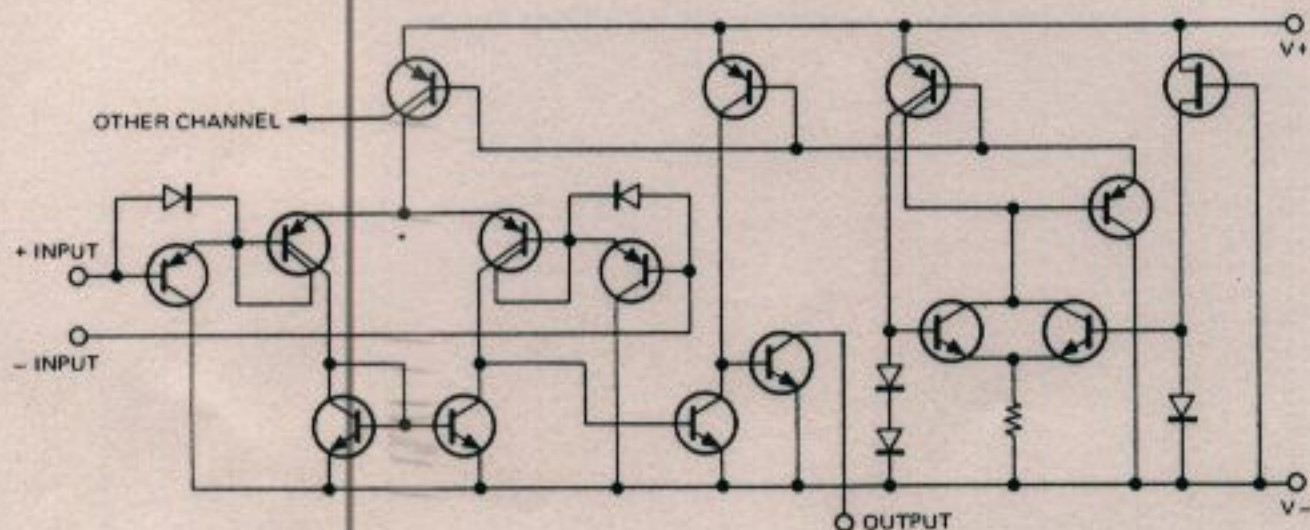
NE555P (TOP VIEW)



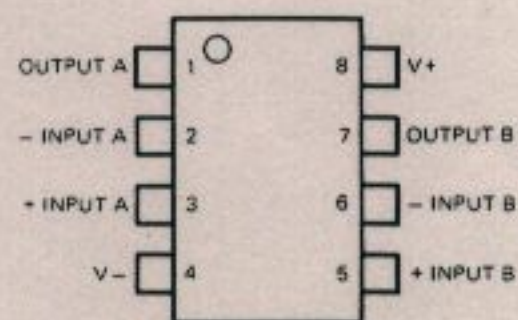
MB3614 Equivalent circuit (Control unit (B) IC204)



MB3614 (TOP VIEW)



NJM2903D Equivalent circuit (Control unit (B) IC205)

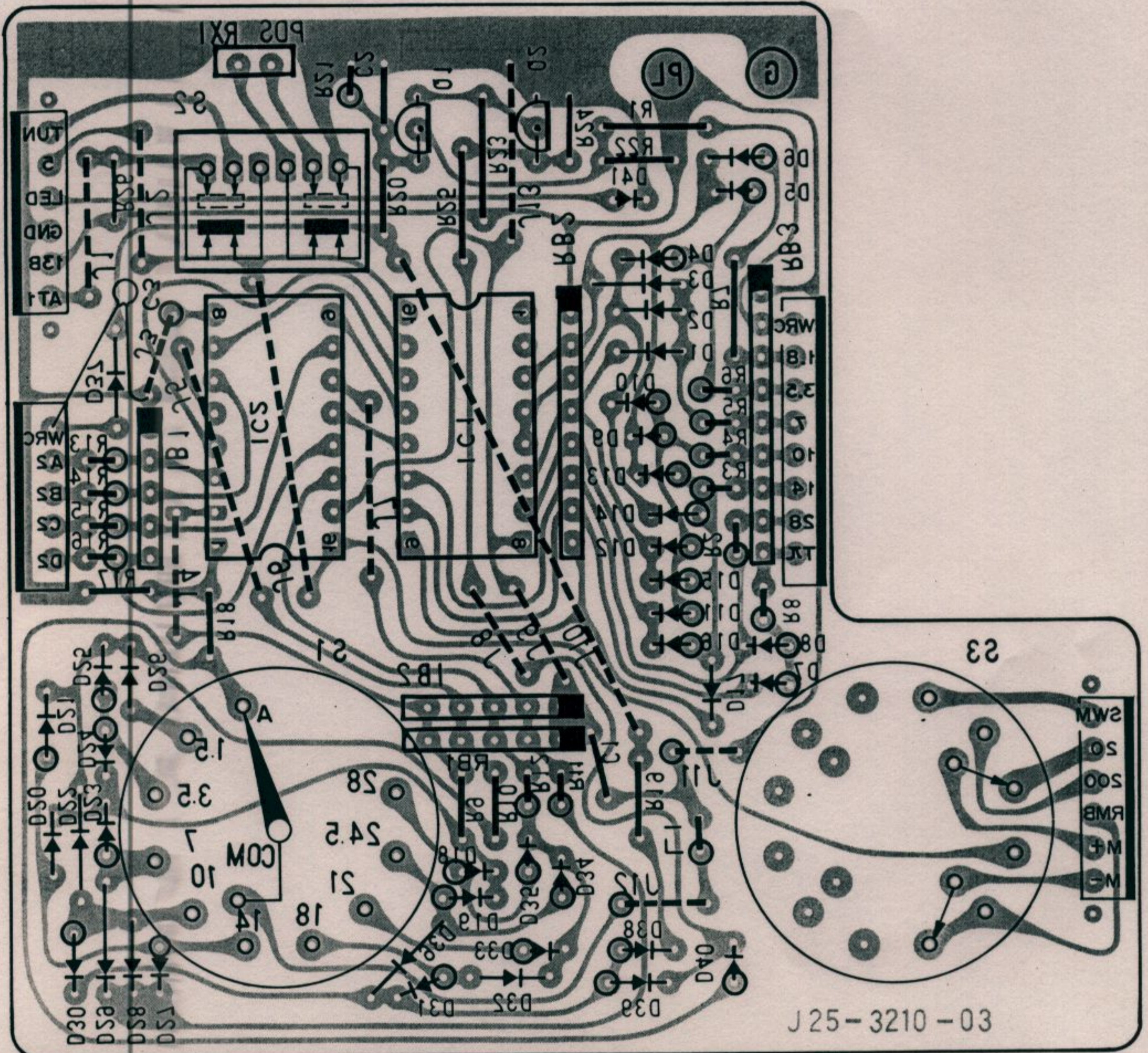


NJM2903D (TOP VIEW)



# AT-250 PC BOARD VIEW

SWITCH UNIT (X41-1520-00) Foil side view



IC1 : SN74LS145N IC2 : MC74HC157N Q1,2 : 2SC1815(Y) D1-40 : 1S1555 or 1N4448 D41 : SR535D

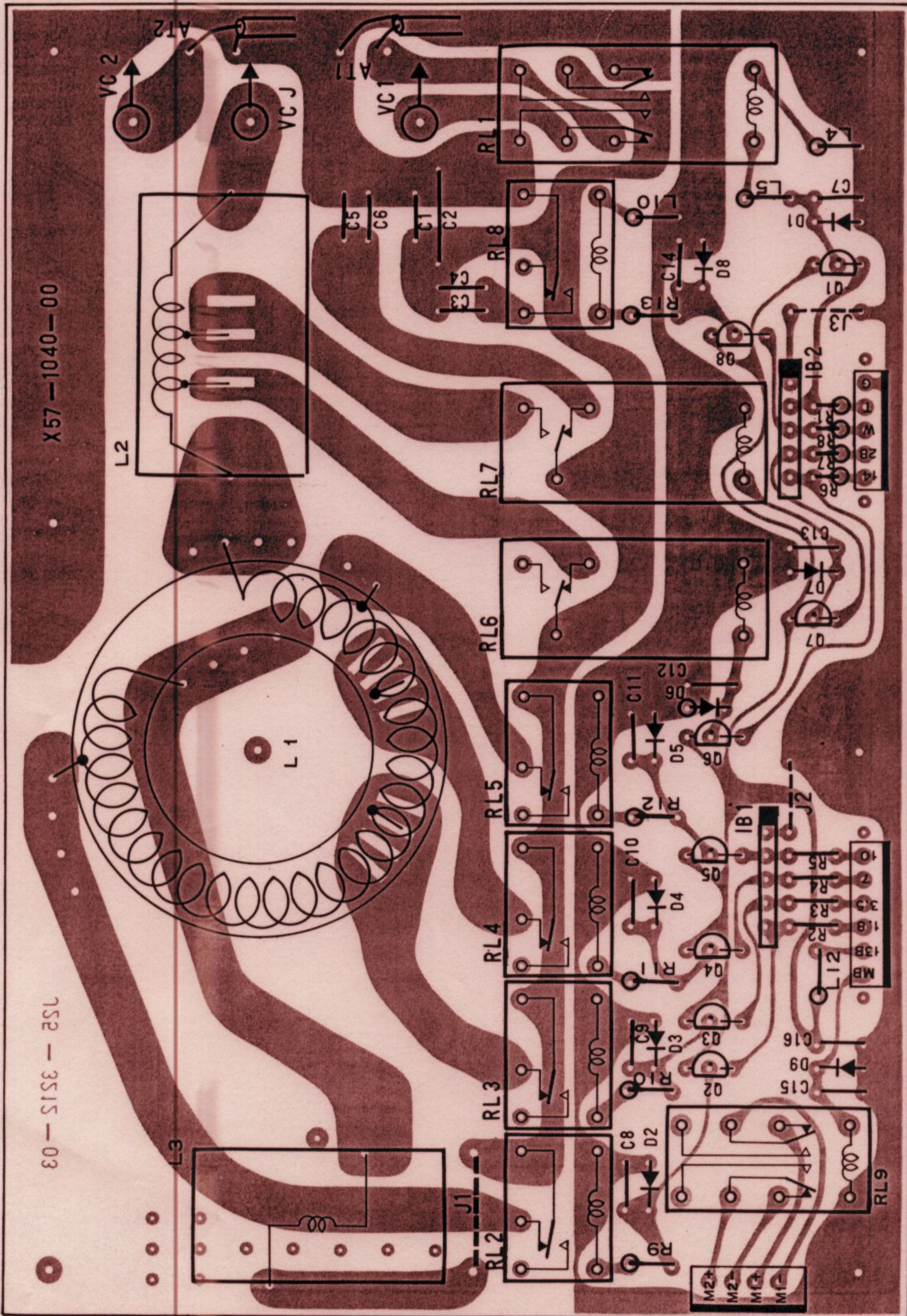
2SA1015  
2SC1815





# PC BOARD VIEW AT-250

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



X57-1040-00

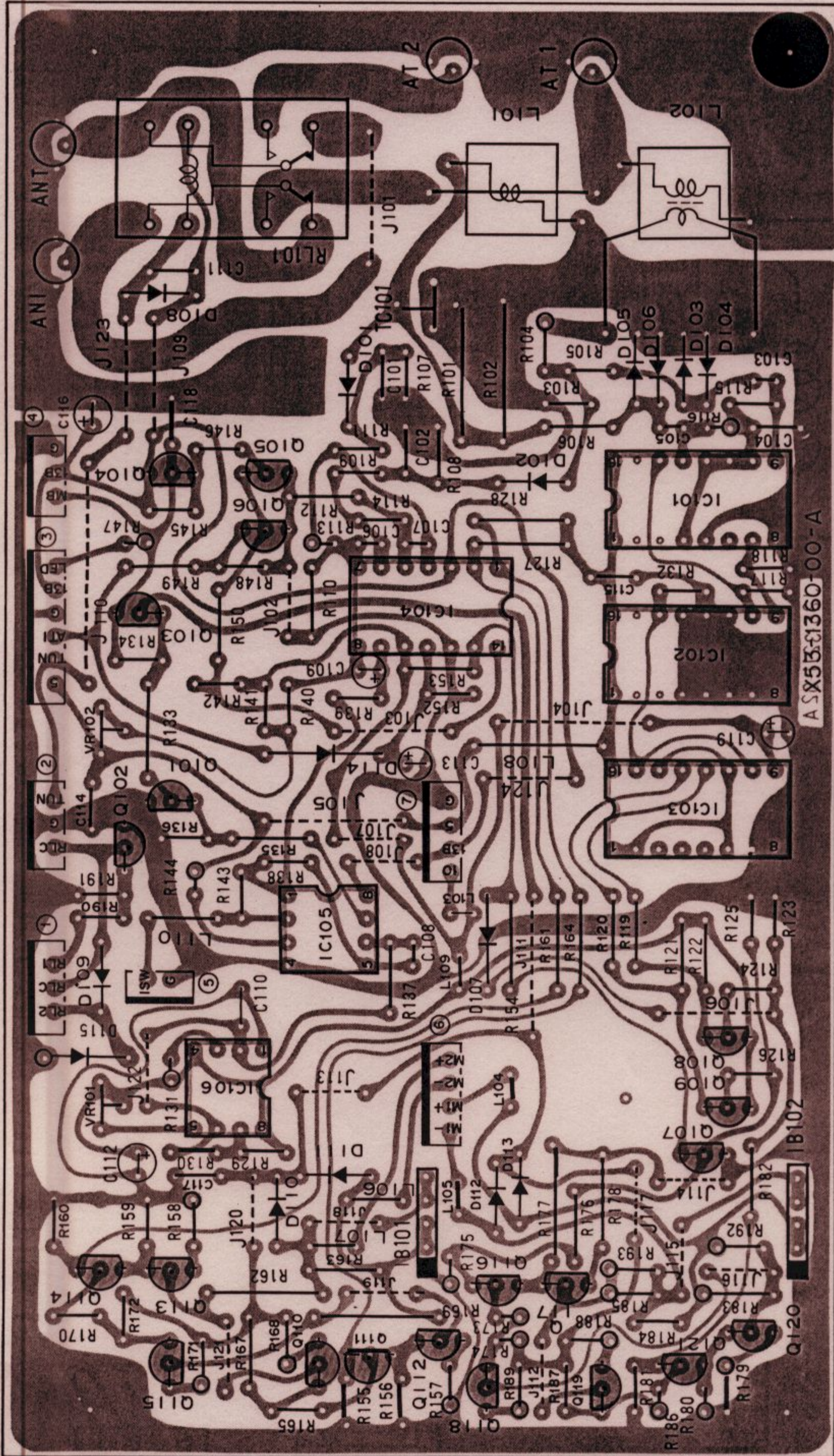
80-5158-25U

O1-8 : 2SA1015(Y) D1-9 : 1S1555 or 1N4448



# AT-250 PC BOARD VIEW

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



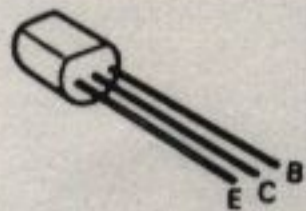
IC101 : HD10116 IC102 : HD10131 IC103 : HD10125 IC104 : NJM2901 IC105 : NJM2904D IC106 : NE555P  
 Q110,115,118,119 : 2SA950(O) Q104 : 2SA966(O) Q103 : 2SA984K(E) Q108,109 : 2SA1015(Y) Q101,102,105-107,111,114,116,121 : 2SC1815(Y)  
 Q112,113,117,120 : 2SC2120(O)  
 D103-106 : 1SS99 D101,102 : 1N60 D107,108,110-114 : 1S1555 or 1N4448 D109 : V08J D115 : U15J



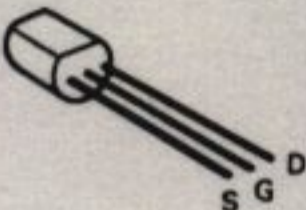
# PC BOARD VIEW AT-250

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

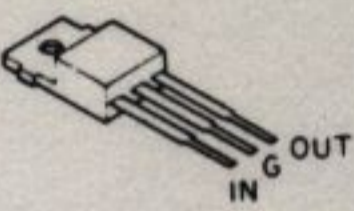
- 2SA950
- 2SA966
- 2SA984K
- 2SA1015
- 2SC1815
- 2SC2120



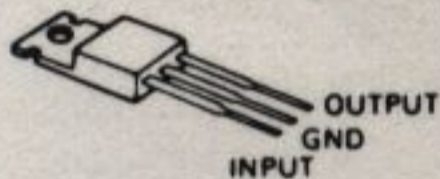
2SK30A



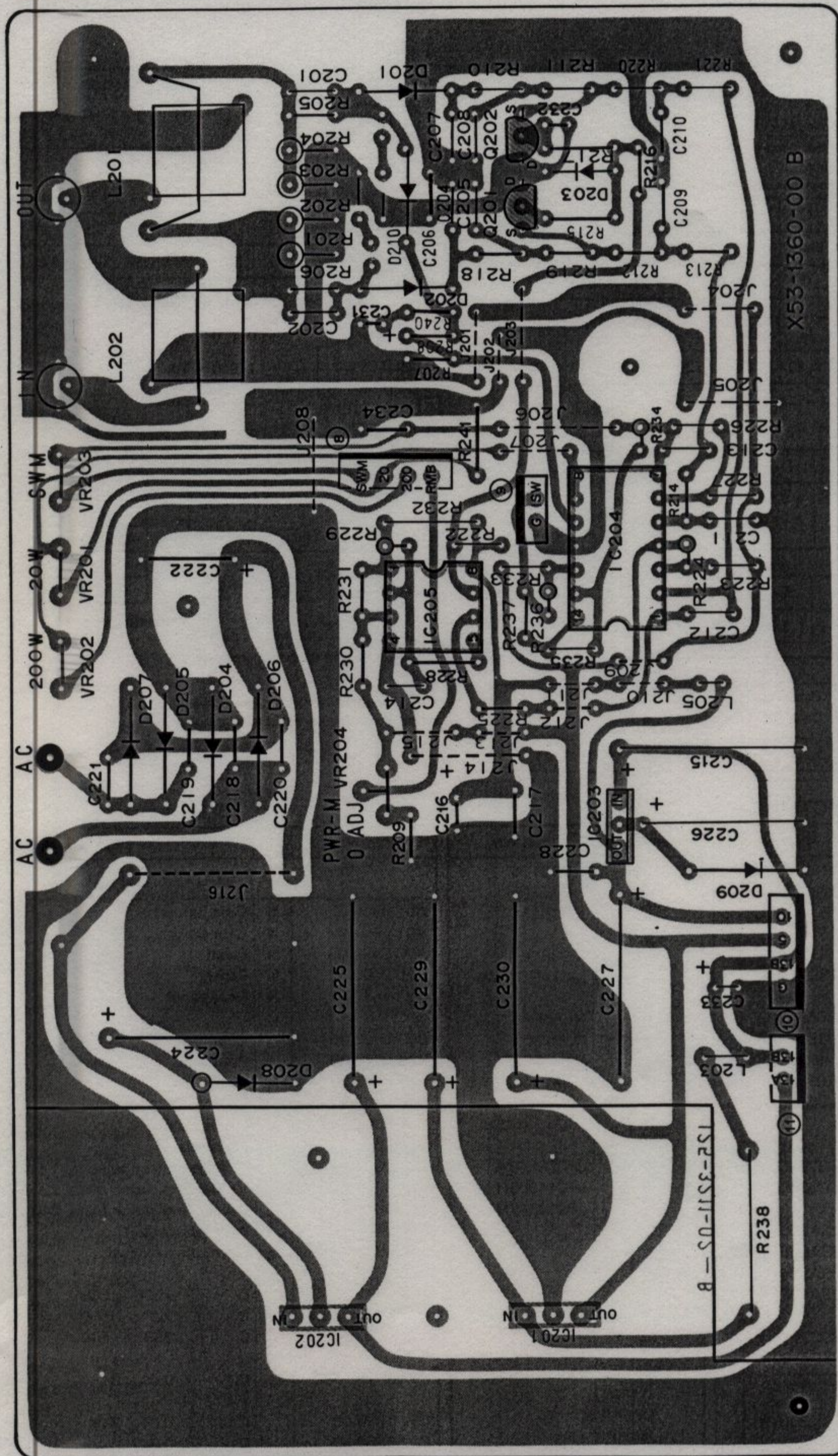
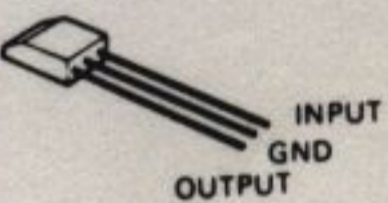
$\mu$ PC14305H



$\mu$ PC14312H



$\mu$ PC78L08A



- IC201 :  $\mu$ PC14305H IC202 :  $\mu$ PC14312H IC203 :  $\mu$ PC78L08A IC204 : MB3614 IC205 : NJM2903D
- Q201,202 : 2SK30A(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 - 20	+ 80 - 20	+ 100 - 0	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

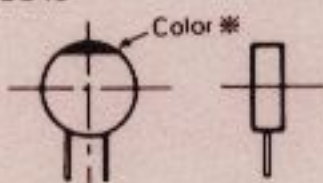
1 0 1 = 100pF

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.	Part No.	Re- marks	Description	Ref. No.
<b>Diode</b>		1N60 1N4448 1S1007 1S1555 1S1587 1SS99  U05B U15J  V03C V08J	<b>IC</b>		HD10116 HD10125 HD10131  MB3614 MC74HC157N  NE555P NJM2901 NJM2903D NJM2904D  SN74LS145N	<b>AT-250 GENERAL</b>			
<b>LED</b>		LT8001P SG238D SR535D			μPC78L08A μPC14305H μPC14312H	A01-0960-02	N	Case (upper)	
<b>TR</b>		2SA950(O) 2SA966(O) 2SA984K(E) 2SA1015(Y)  2SC1815(Y) 2SC2120(O) 2SC2235(O)				A01-0961-02	N	Case (lower)	
<b>FET</b>		2SK30(GR)				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
						B31-0645-05	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



## PARTS LIST

Part No.	Re- marks	Description	Ref. No.	Part No.	Re- marks	Description	Ref. No.	Q'ty
E04-0152-05		M type receptacle x 5	J1-5	<b>SWITCH UNIT (X41-1520-00)</b>				
E06-0852-05		8P DIN socket ACC	J6	CK45F1H103Z		C 0.01	C2	1
E07-0751-05		7P DIN plug		C91-0456-05		C 0.047	C1,3	2
E07-0851-05		8P DIN plug		E10-0652-05	N	Wire holder		2
E08-0203-25		2P connector DC POWER	J7	E40-3010-05		Mini connector 5P		1
E18-0351-05		3P inlet AC POWER	J8	E40-3013-05		Mini connector 8P		1
E30-1643-15		AC cord ass'y Accessory <b>K,M</b>		L40-1511-12		Ferri-inductor 150μH	L1	1
E30-1644-15		AC cord ass'y Accessory <b>T</b>		R90-0188-05		Inline block 0.01 x 4	IB1,2	2
E30-1645-05		AC cord ass'y Accessory <b>W</b>		R90-0521-05		Resistor block 4.7kΩ x 7	RB2	1
E30-1747-05	N	Remote cable (A) Accessory 8P-8P		R90-0533-05		Resistor block 10kΩ x 8	RB3	1
E30-1748-05	N	GND cable Accessory		R90-0571-05	N	Resistor block 33kΩ x 4	RB1	1
E31-2199-05	N	Connector with lead LED		R92-0150-05		Short jumper		12
H01-4515-04	N	Packing carton (inside)		S01-1435-05	N	Rotary switch BAND	S1	1
H10-2567-02		Packing fixture (F)		S01-1436-05	N	Rotary switch METER	S3	1
H10-2568-02		Packing fixture (R)		S40-2433-05		Push switch TUNE	S2	1
H12-1319-04		Cushion		<b>CONTROL UNIT (X53-1360-00) (A), (B)</b>				
H20-1420-03		Protective cover		C05-0324-05	N	Ceramic trimmer 60P	TC101	1
H25-0105-04		Protective bag Cable		CC45CH1H101J		C 100P	C201,202	2
J02-0323-05		Foot x 4		CC45SL1H470J		C 47P	C232	1
J02-0427-04		Assistant foot		CE02W0J101M		E 100 6.3V	C224,226	2
J21-2573-04		Foot mounting hardware x 2		CE02W1C101M		E 100 16V	C215,225,227,229, 230	5
J32-0768-04		Hex. boss x 3		CE04W1C100M		E 10 16V	C112,113,119	3
J61-0401-05		Nylon band x 10		CE04W1C101M		E 100 16V	C216	1
K23-0753-04		Pointer knob x 3 ANT,METER,BAND		CE04W1E100M		E 10 25V	C116	1
K29-0758-04		Push knob x 2 POWER,TUNER		CE04W1E470M		E 47 25V	C233	1
K29-0787-04	N	Push knob x 2 TUNE		CE04W1H010M		E 1 50V	C109	1
L01-8074-05	N	Transformer	T1	CE04W1HR47M		E 0.47 50V	C231	1
N09-0256-05		GND screw x 3		CK45B1H102K		C 0.001	C103,105-108	5
N09-0641-05		Round screw x 2		CK45B1H222K		C 0.0022	C204,207	2
N14-0115-05		Flange nut GND		CK45F1H103Z		C 0.01	C101,102,111, 218-221,234	8
N14-0509-05		Wing nut GND		CQ92M1H333K		ML 0.033	C110	1
N15-1026-41		Flat washer		CQ92M1H562K		ML 0.0056	C214	1
N15-1040-46		Flat washer x 2 GND		C90-0807-05		E 2200 25V	C222	1
N30-2004-41		Round screw x 2		C91-0456-05		C 0.047	C104,114,115,117, 118,206,209-213, 217,228	13
N30-2606-41		Round screw x 4		C91-0457-05		C 0.022	C205,208	2
N30-3006-41		Round screw x 10		E04-0154-05		Coax. connector		6
N30-4016-46		Round screw GND		E23-0512-05		Round terminal		2
N32-2606-41		Flat screw x 2		E31-2170-05		Jumper wire		28
N33-3006-45		Round flat screw x 2						
N35-3006-41		Bind screw x 17						
N87-2606-41		Self tapping screw						
N87-3006-41		Self tapping screw x 12						
N87-3012-46		Self tapping screw x 8						
N89-3005-46		Bind 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						



## PARTS LIST

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	<b>AT UNIT (X57-1040-00)</b>				
E40-0373-05		Mini connector 3P		3	C02-0022-05		Variable cap.	VC1,2	2
E40-0473-05		Mini connector 4P		3	CC45CH2H121J		C 120P 500V	C2	1
E40-0673-05		Mini connector 6P		1	CC45CH2H330J		C 33P 500V	C4	1
E40-3007-05		Pin connector 2P		1	CC45CH2H470J		C 47P 500V	C3	1
E40-3009-05		Pin connector 4P		1	CC45CH2H820J		C 82P 500V	C1,5,6	3
F01-0799-04	NΔ	Heat sink		1	CK45F1H103Z		C 0.01	C7-16	10
F20-0078-05		Insulating plate		1	D22-0408-05		Coupling		2
F29-0014-05		Shoulder washer		1	D40-0623-25		Gear ass'y 1/200		1
J31-0502-04		PC board collar		8	D40-0624-25		Gear ass'y 1/300		1
J42-0428-05		PC board bushing		8	E40-0473-05		Mini connector 4P		1
L39-0415-15		Detector coil A	L102	1	J19-1363-05		Lead holder		2
L39-0416-05		Detector coil B	L101,202	2	J61-0401-05		Nylon band		1
L39-0419-05	N	Detector coil	L201	1	L34-2194-05	N	Tuning coil A	L1	1
L40-1011-12		Ferri-inductor 100μH	L103-107,110, 203	7	L34-2195-05	N	Tuning coil B	L2	1
L40-1011-13		Ferri-inductor 100μH	L108	1	L34-2196-05	N	Tuning coil C	L3	1
L40-1021-12		Ferri-inductor 1mH	L109	1	L40-1011-12		Ferri-inductor 100μH	L4,5,10,12	4
L40-1511-12		Ferri-inductor 150μH	L205	1	N09-0641-05		Round screw		4
N10-2030-41		Nut		2	N87-3006-41		Self tapping screw		11
N30-3010-41		Round screw		2	N88-3006-41		Flat tapping screw		4
N87-3006-41		Self tapping screw		1	R90-0188-05		Inline block 0.01 x 4	IB1,2	2
R12-2401-05		Trim. pot. 5kΩ (B)	VR201,203	2	R92-0150-05		Short jumper		2
R12-2410-05		Trim. pot. 5kΩ (B)	VR102,204	2	S51-1417-05		Relay	RL6,7	2
R12-3434-05		Trim. pot. 10kΩ (B)	VR101	1	S51-1420-05	N	Relay	RL2-5,8	5
R12-3440-05	N	Trim. pot. 20kΩ (B)	VR202	1	S51-2413-05	N	Relay	RL1	1
RC05GF2H101J		Solid 100Ω 1/2W	R101,102, 201-204	6	S51-2414-05	N	Relay	RL9	1
RC05GF2H4R7J		Solid 4.7Ω 1/2W	R162,169	2	T42-0303-05		Motor	M1,2	2
RS14AB3D470J		MF 47Ω 2W	R238	1					
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:  $50\Omega$
- 3) Dissipation: 20W continuous or greater, 150W continuous or greater

#### 3. RF Dummy Load

- 1) Impedance:  $20\Omega$ ,  $150\Omega$
- 2) Dissipation: 150W or greater

Note: The length of both the  $150\Omega$  and  $20\Omega$  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.

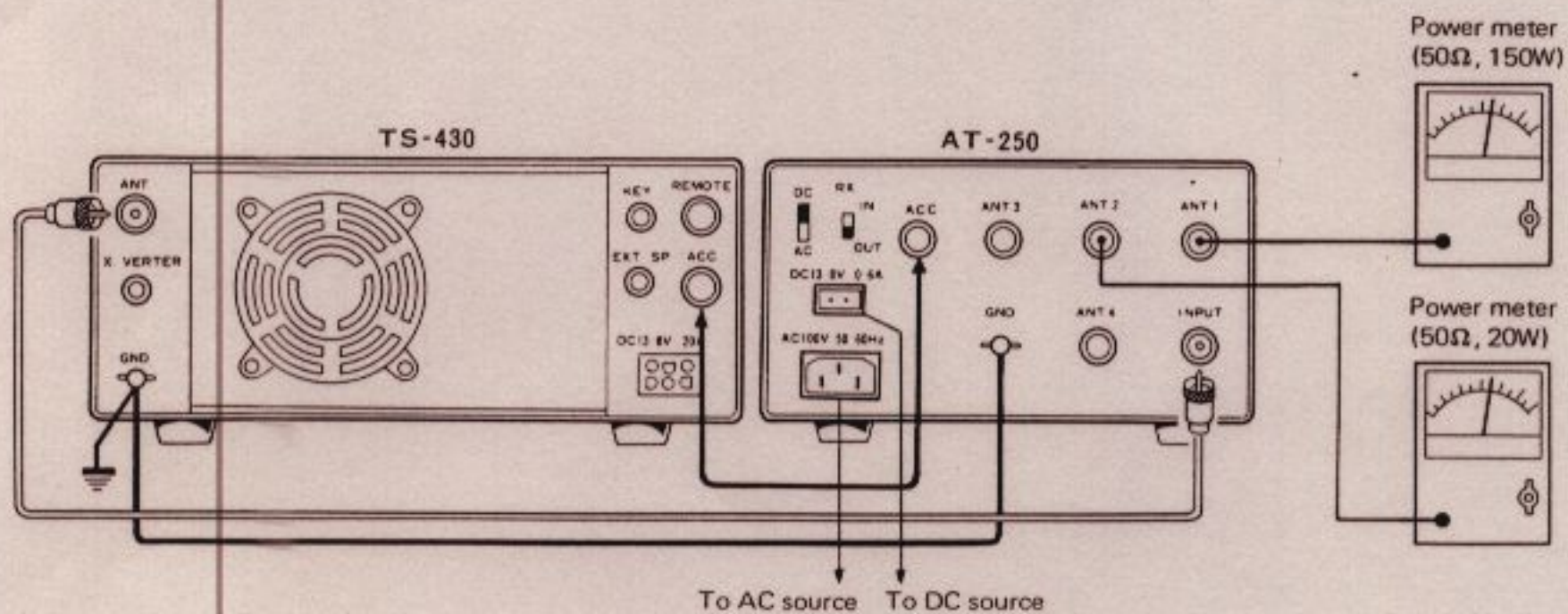
#### Front panel

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.

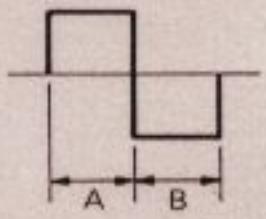
#### Rear panel

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 $50\Omega$ , 150W power meter.	
ANT2:	Connect a $50\Omega$ , 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 5				13.8V±0.5V 5V±0.5V
	2) Power SW : OFF 3) AC/DC SW : AC (Connect to AC power.) Power SW : ON							
2. Meter zero-point adjustment	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, 200W and SWR positions.	
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 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 deflects 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	Oscilloscope	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.	 <p>A=B (Duty 50%)</p>



## 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.)	
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.

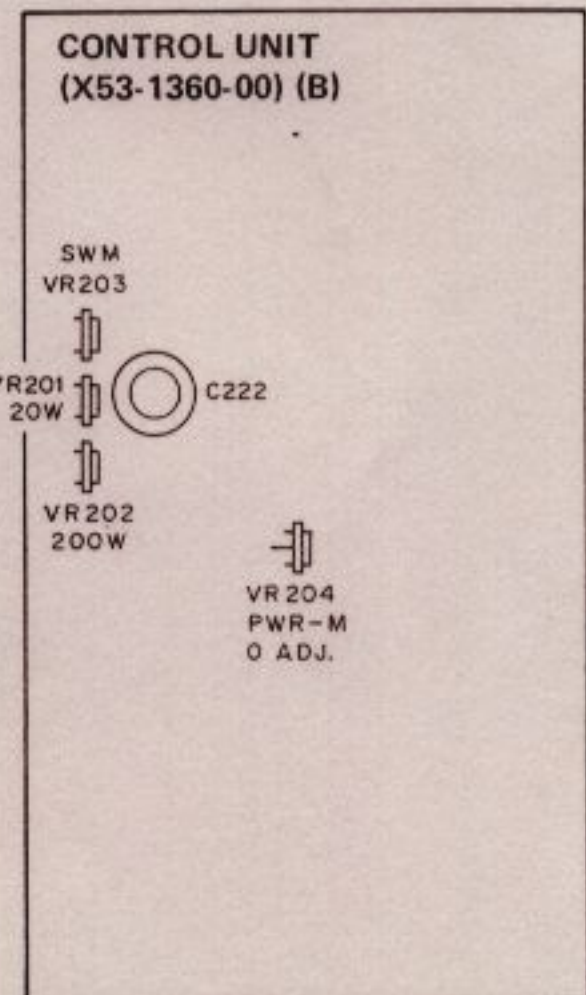
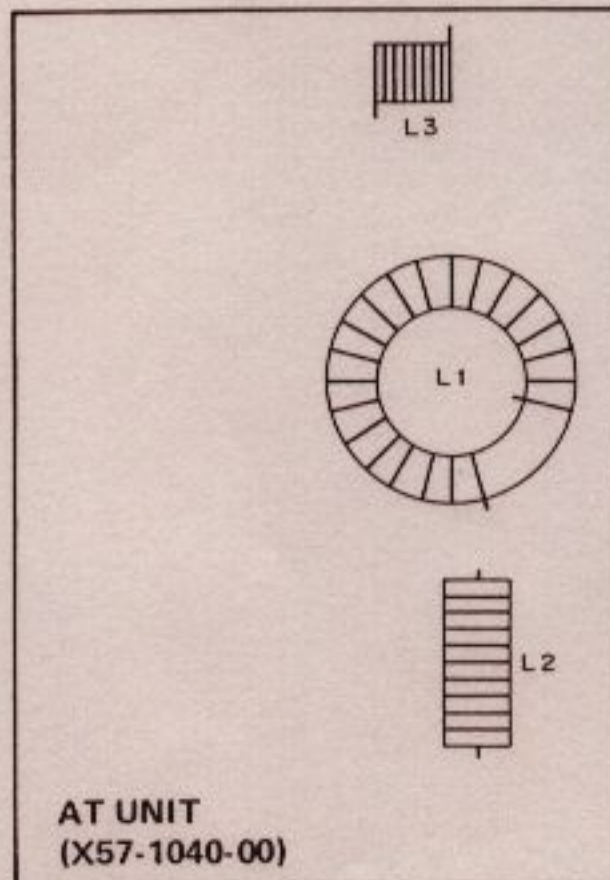
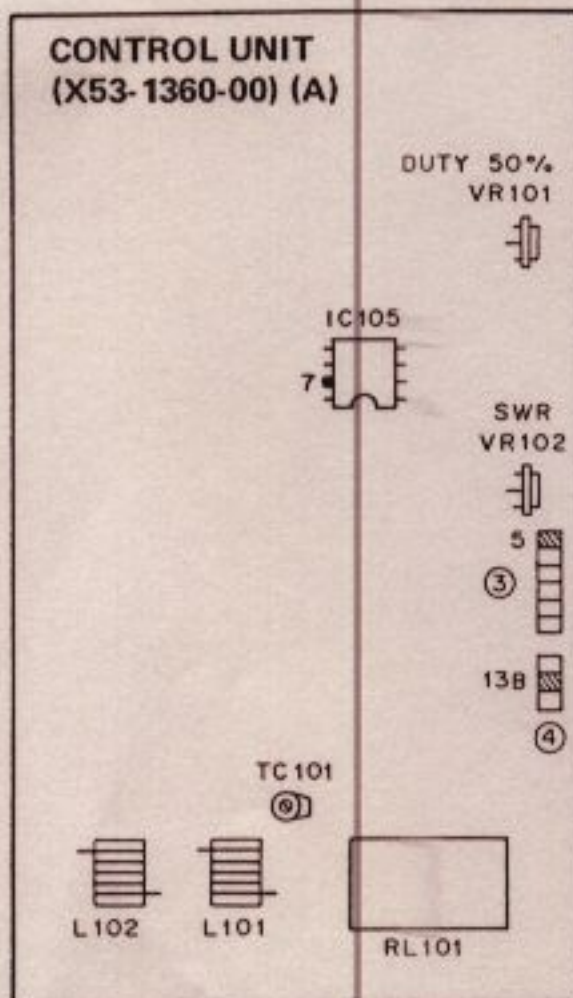
TC101





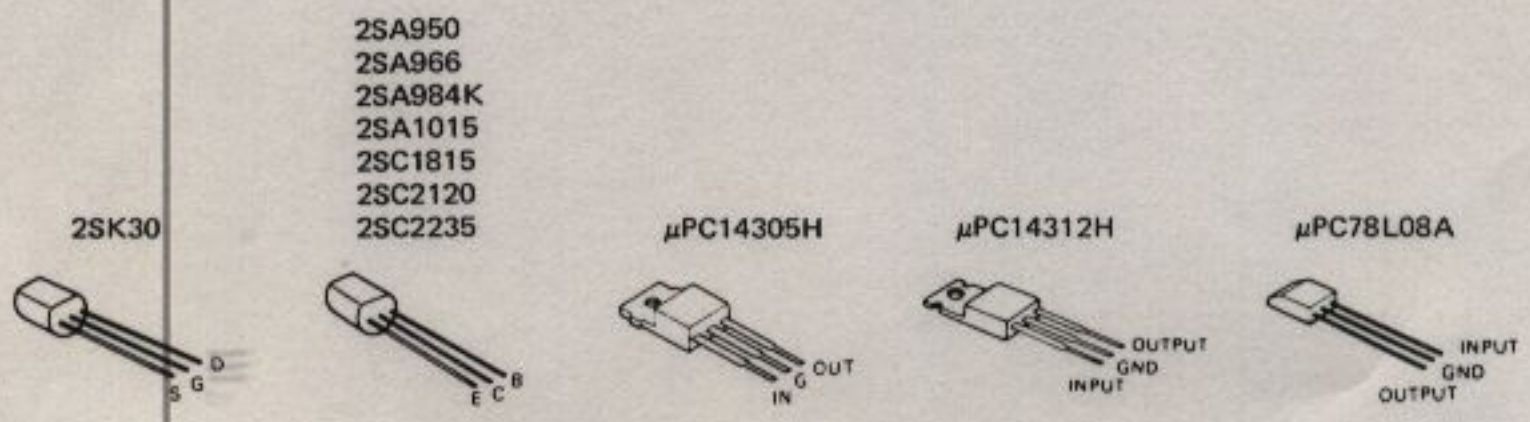
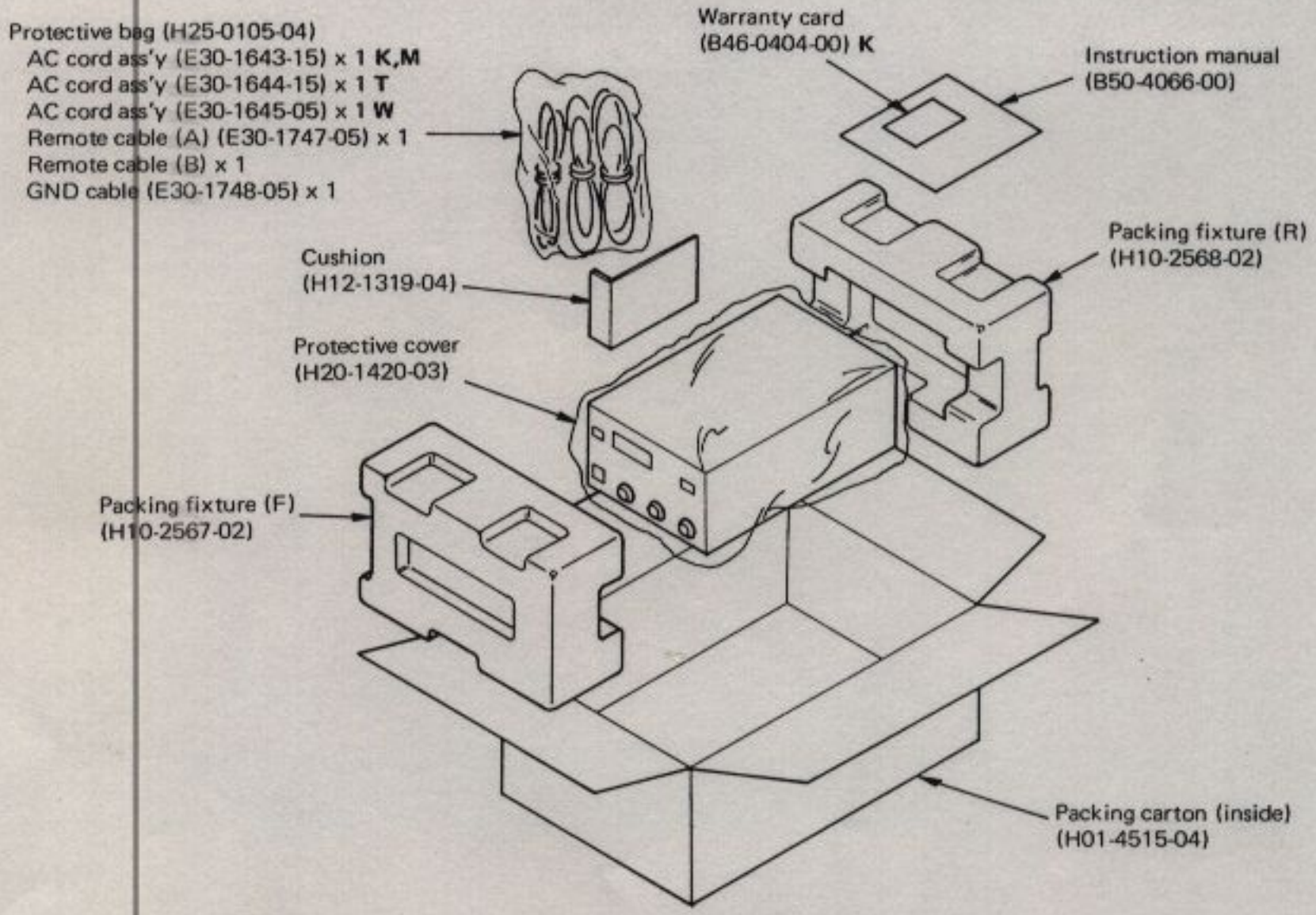
## ADJUSTMENT

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.





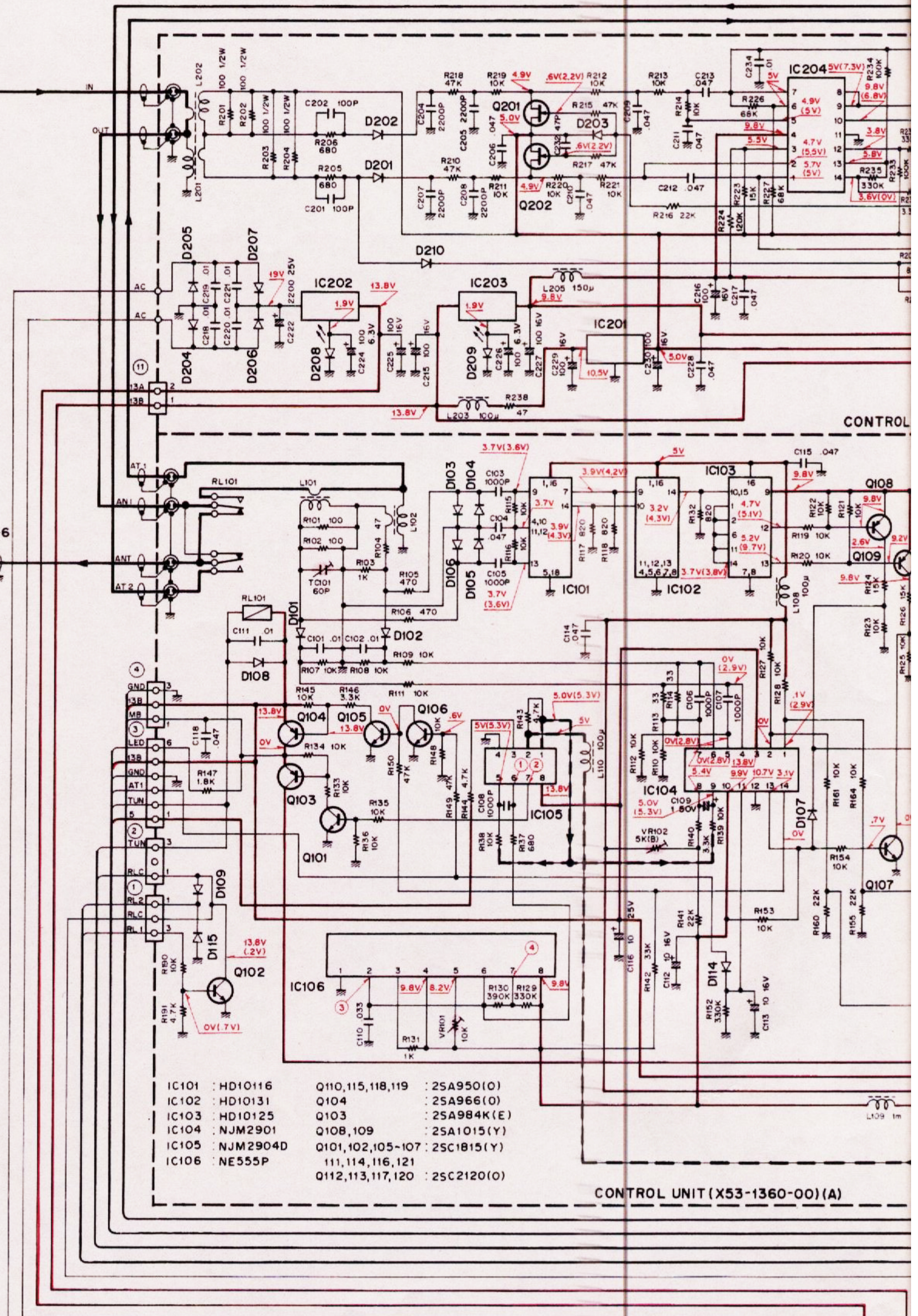
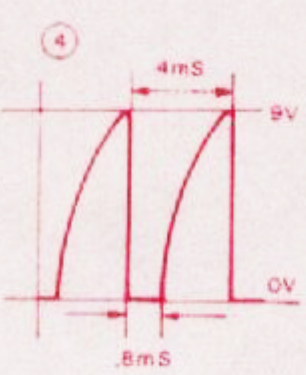
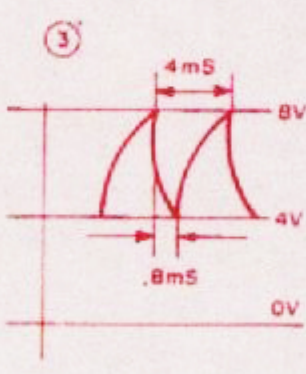
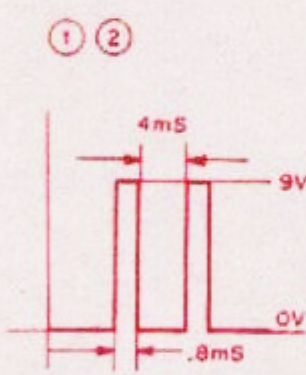
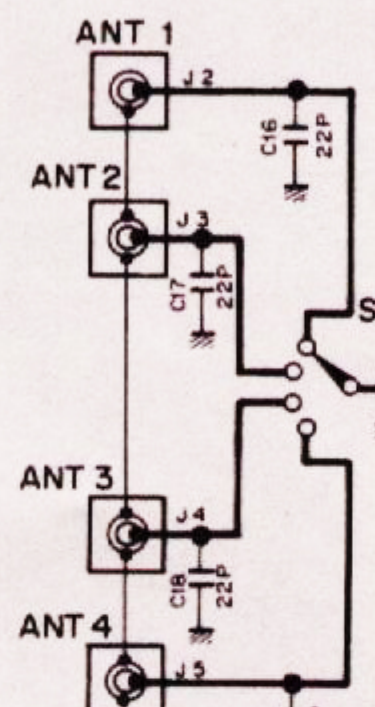
## PACKING





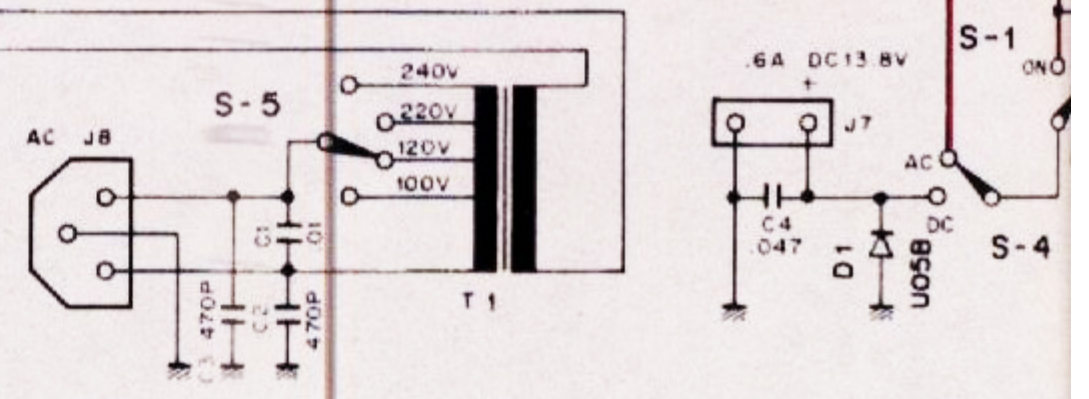
- IC201 :  $\mu$ PC14305H
- IC202 :  $\mu$ PC14312H
- IC203 :  $\mu$ PC78L08A
- IC204 : MB3614
- IC205 : NJM2903D

- Q201, 202 : 2SK30(GR)
- D204~207 : V03C
- D208, 209 : LT8001P
- D201, 210 : 1S1587
- D202 : 1S1007
- D203 : 1S1555 or 1N4448



- IC101 : HD10116
- IC102 : HD10131
- IC103 : HD10125
- IC104 : NJM2901
- IC105 : NJM2904D
- IC106 : NE555P
- Q110, 115, 118, 119 : 2SA950(O)
- Q104 : 2SA966(O)
- Q103 : 2SA984K(E)
- Q108, 109 : 2SA1015(Y)
- Q101, 102, 105-107 : 2SC1815(Y)
- 111, 114, 116, 121 : 2SC2120(O)
- Q112, 113, 117, 120 : 2SC2120(O)

- D103-106 : 1S599
- D101, 102 : 1N60
- D107, 108, 110-114 : 1S1555 or 1N4448
- D109 : V08J
- D115 : U15J

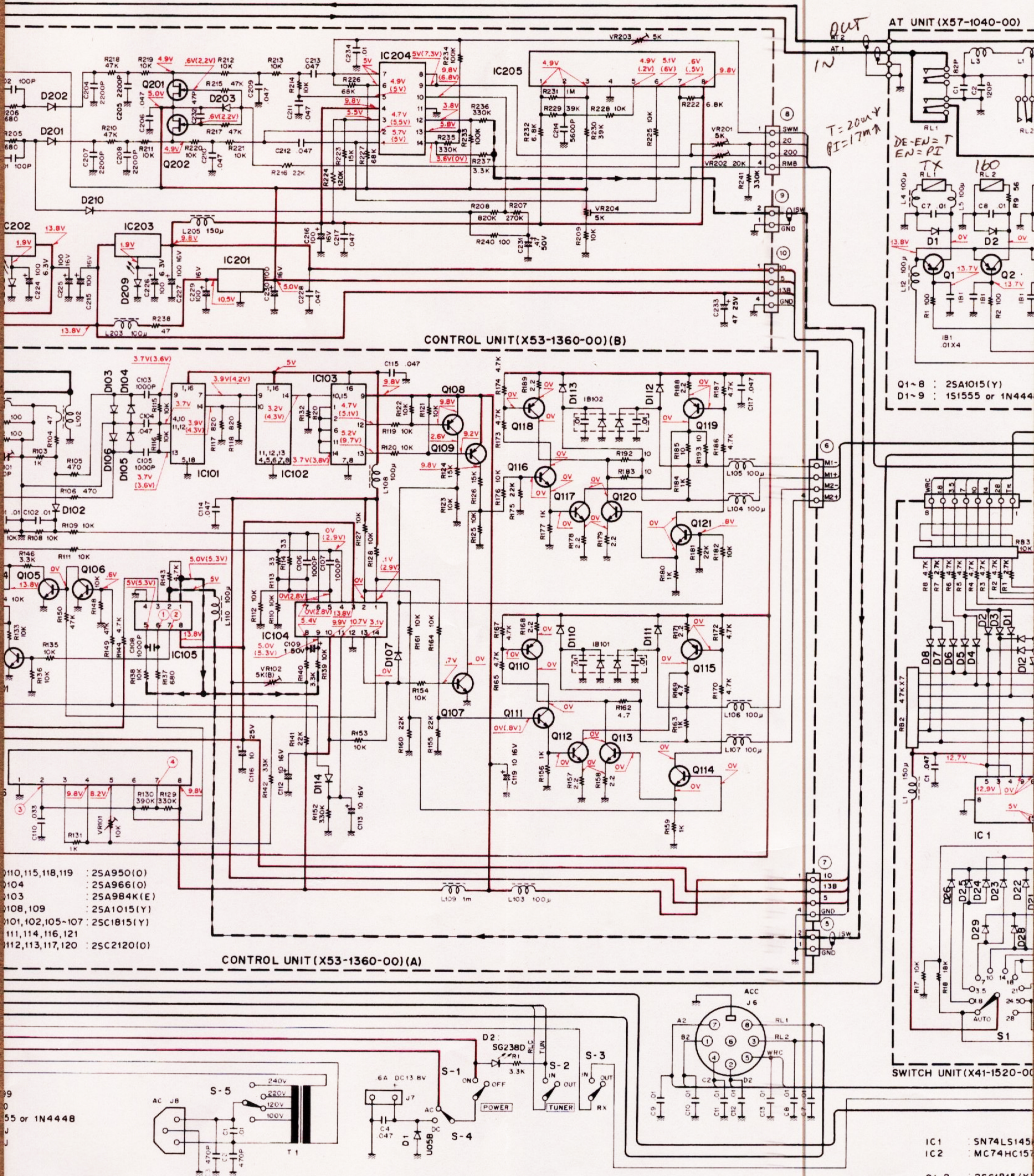




Common DC Line

# SCHEMATIC DIAGRAM

The voltages n  
TS-430S's fre  
BAND SW : A



- Q110, 115, 118, 119 : 2SA950(O)
- Q104 : 2SA966(O)
- Q103 : 2SA984K(E)
- Q108, 109 : 2SA1015(Y)
- Q101, 102, 105-107 : 2SC1815(Y)
- Q111, 114, 116, 121
- Q112, 113, 117, 120 : 2SC2120(O)

- Q1 ~ 8 : 2SA1015(Y)
- D1 ~ 9 : 1S1555 or 1N444

- IC1 : SN74LS145
- IC2 : MC74HC15
- Q1, 2 : 2SC1815(Y)



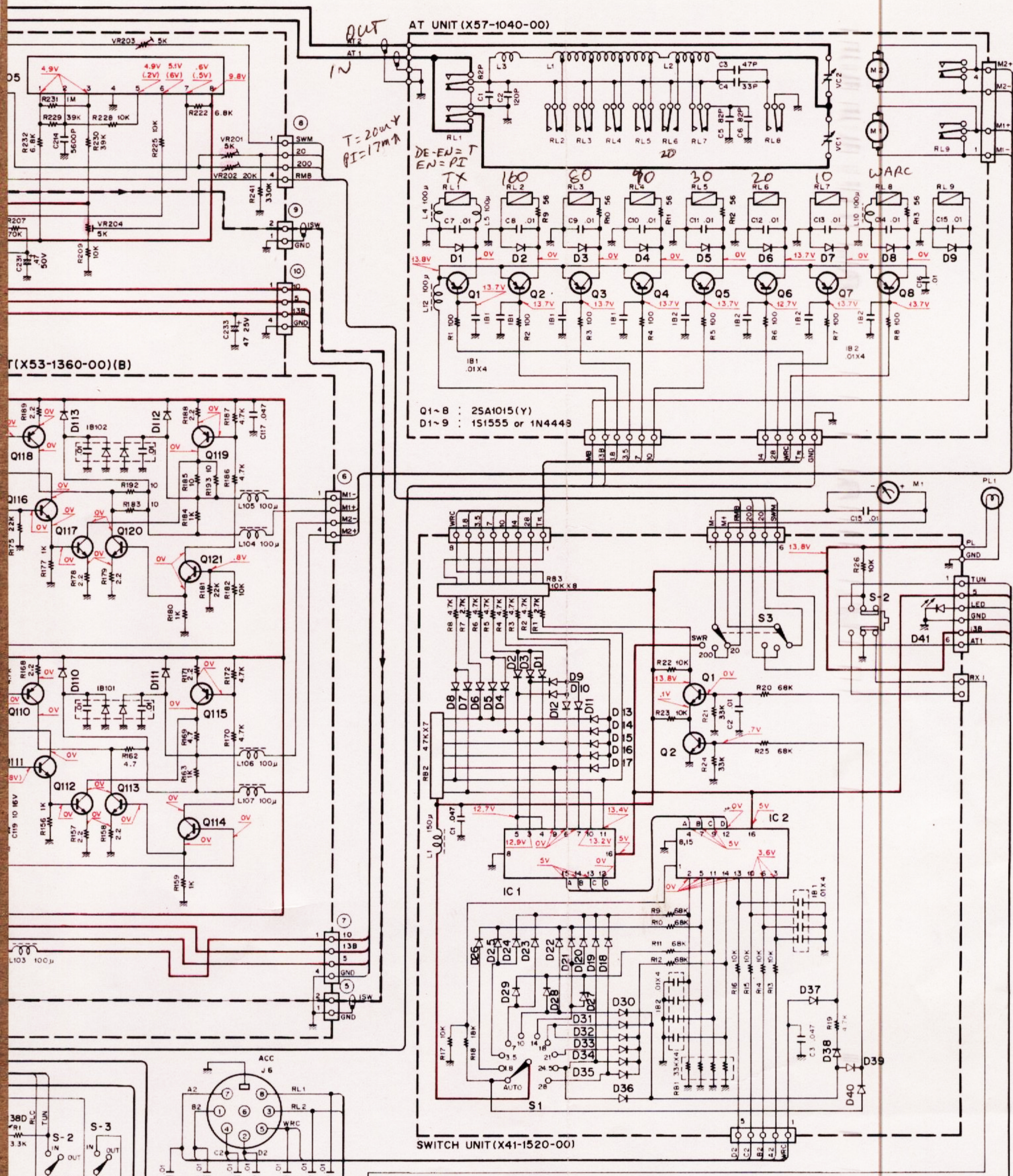
# MATIC DIAGRAM

The voltages measured when receiving. ( ) : TX.

TS-430S's frequency : 14.175MHz.

BAND SW : AUTO, TUNER SW : ON, TUNE SW : ON

# AT-250



- IC 1 : SN74LS145N
- IC 2 : MC74HC157N
- D1-40 : 1S1555 or 1N4448
- D41 : SR535D
- Q1, 2 : 2SC1815(Y)

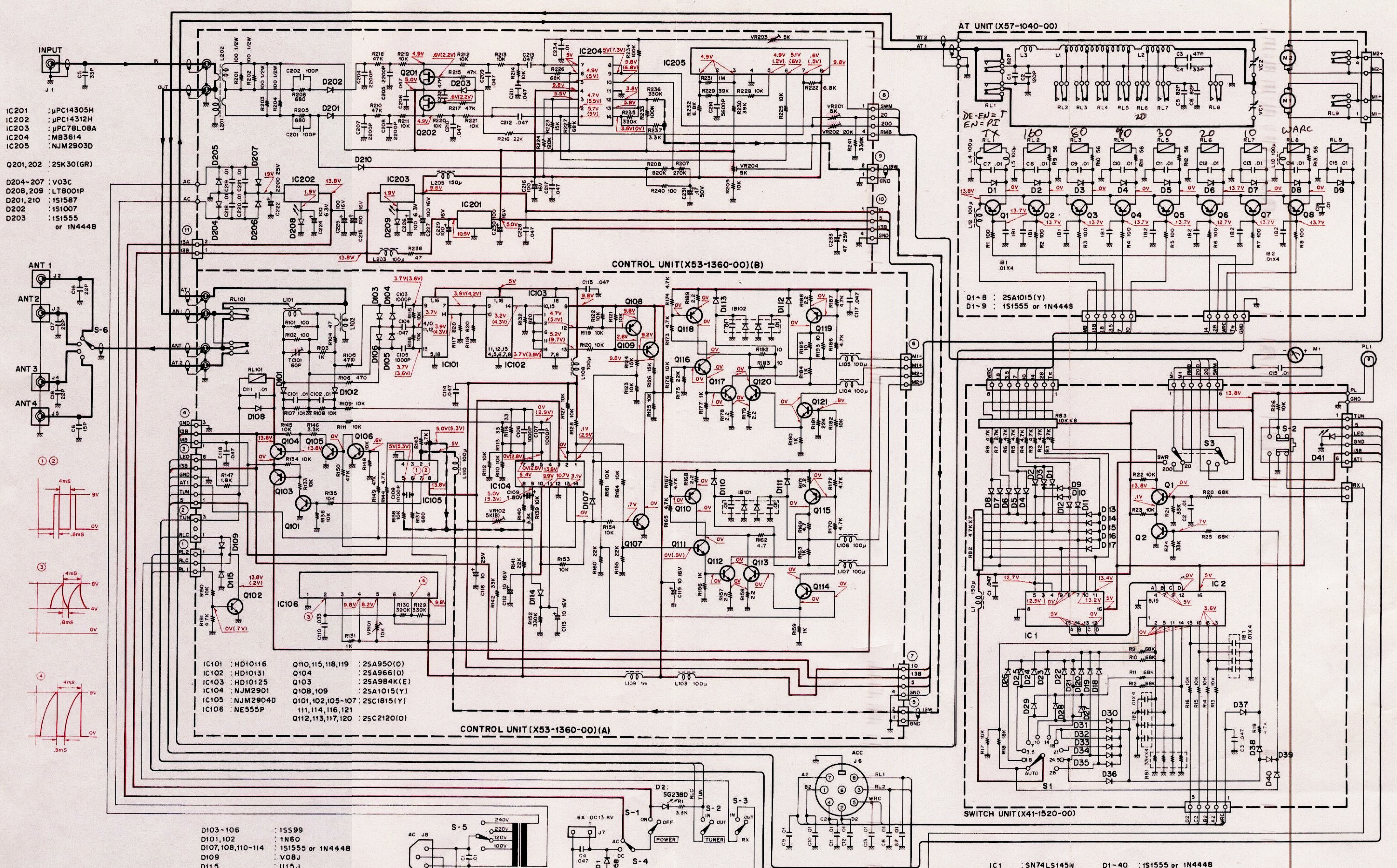


Signal Line    Control Line    Common DC Line

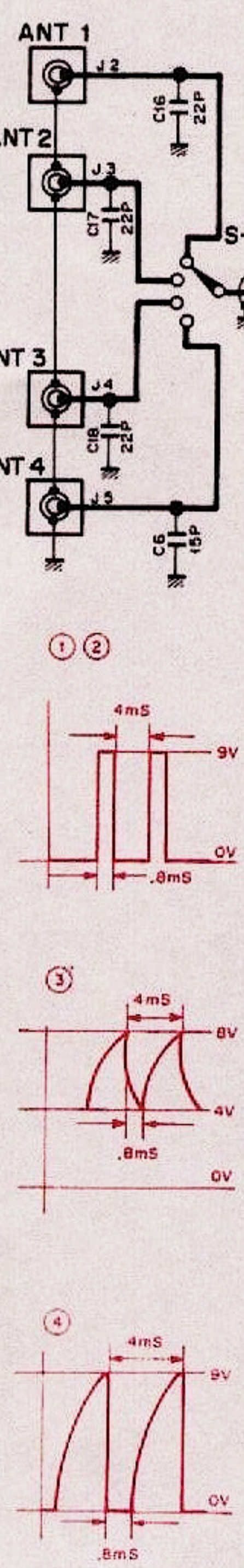
# SCHEMATIC DIAGRAM

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

# AT-250



- IC201 : μPC14305H
- IC202 : μPC14312H
- IC203 : μPC78L08A
- IC204 : MB3614
- IC205 : NJM2903D
- Q201, 202 : 2SK30(GR)
- D204~207 : V03C
- D208, 209 : LT8001P
- D201, 210 : 1S1587
- D202 : 1S1007
- D203 : 1S1555 or 1N4448



- IC101 : HD10116
- IC102 : HD10131
- IC103 : HD10125
- IC104 : NJM2901
- IC105 : NJM2904D
- IC106 : NE555P
- Q110, 115, 118, 119 : 2SA950(O)
- Q104 : 2SA966(O)
- Q103 : 2SA984K(E)
- Q108, 109 : 2SA1015(Y)
- Q101, 102, 105-107 : 2SC1815(Y)
- 111, 114, 116, 121 : 2SC2120(D)
- Q112, 113, 117, 120

- D103-106 : 1S599
- D101, 102 : 1N60
- D107, 108, 110-114 : 1S1555 or 1N4448
- D109 : V08J
- D115 : U15J

- IC1 : SN74LS145N
- IC2 : MC74HC157N
- D1-40 : 1S1555 or 1N4448
- D41 : SR535D

2  
3  
4  
5  
6  
7



## SPECIFICATIONS

1.	Frequency range	All amateur bands from 1.8 – 29.7 MHz
2.	Input impedance	50 ohms unbalanced
3.	Output impedance	20 – 50 ohms unbalanced
4.	Insertion loss	0.8 dB or less
5.	Pass through power	100W (200W PEP)
6.	SWR value for motor stop	1.2:1 or less
7.	Min. power for activation	3W
8.	Max. tuning time	Within 15 seconds
9.	Power meter (peak value reading)	± 10% at 100 W ± 10% at 10W
10.	Power consumption (current)	15W AC 13.8V DC 600 mA
11.	Power requirement	120V, 220V, or 240V AC selectable 13.8V (12–16) DC
12.	Dimensions	W174 (174) x H96 (107) x D257 (289) mm ( ) shows projections included.
	Weight	4.2 kg (9.24 lb.)
13.	Package dimensions	W385 x H167 x D264 mm Capacitance: 0.017 m <sup>3</sup>
14.	Semiconductors	ICs 13 FETs 2 Transistors 31 Diodes 77

## ACCESSORIES

Remote cable (A)	1
Remote cable (B)	1
AC power cable	1
Grounding wire	1
Instruction manual	1

Specifications may be subject to change without notice for technical improvement.

## TRIO-KENWOOD CORPORATION

Shionogi Shibuya Building, 17-5, 2-chome Shibuya, Shibuya-ku, Tokyo 150, Japan

### TRIO-KENWOOD COMMUNICATIONS

1111 West Walnut Street, Compton, California 90220, U.S.A.

TRIO-KENWOOD COMMUNICATIONS, GmbH

D-6374 Steinbach-TS, Industriestrasse, 8A West Germany

TRIO-KENWOOD ELECTRONICS, N.V.

Leuvensesteenweg 504 B-1930 Zaventem, Belgium

TRIO-KENWOOD (AUSTRALIA) PTY. LTD. (INCORPORATED IN N.S.W.)

4E Woodcock Place, Lane Cove, N.S.W. 2066, Australia